



STUDENTS AUDITING & VERIFYING EFFICIENT RESOURCE USE

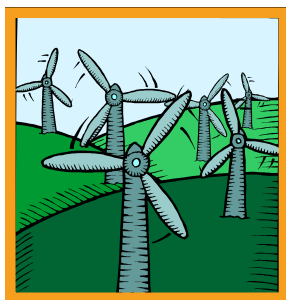
An environmental science curriculum for middle school students

Earth SAVER

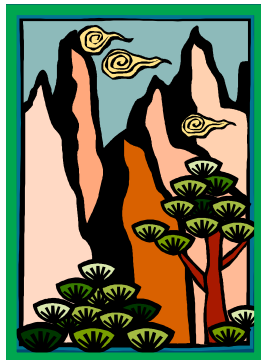
Students Auditing & Verifying Efficient Resource use

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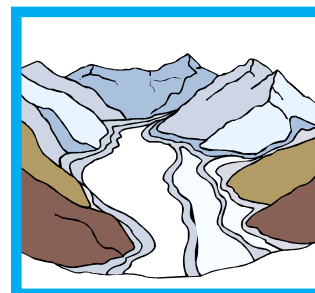
Produced by Clark County Environmental Services
PO Box 9810 🌐 Vancouver, WA 98666-9810
360.397.6118 ext. 4352



Energy Resources



Material Resources



Water Resources

Contributors:

Peter DuBois, Clark County
Susan Duncan, Environmental Information Cooperative
Jesse Elam, Independent Consultant
Sally Fisher, Clark County
Tina Kruger, Environmental Educator
Ginger May, Waste Connections Inc.
Chery Sullivan, Waste Connections Inc.
Rochelle Hohlfeld, AmeriCorp
Genece Klein, Illustrator

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Earth SAVER - Students Auditing and Verifying Efficient Resource use©
Clark County Environmental Services (text) and Genece Klein (illustrations)

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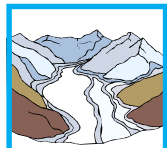
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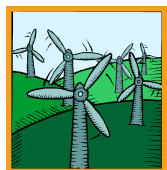
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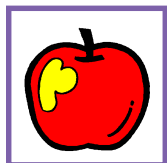
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A HELPING HAND

MATERIAL RESOURCES

Chery Sullivan is a *Recycling Coordinator* for Waste Connections. For the last 3 1/2 years Chery has worked with school, scout and adult groups to inform and encourage waste reduction and recycling.

cherys@wcnx.org
360-737-1727 or 360-921-5205

Ginger May has worked in the informal environmental education field for several years as a *Recycling Educator* and *Interpretive Naturalist* at Mount St. Helens. She earned a Bachelor of Science degree in Forestry from Purdue University and also spent several years as a cartographer and volunteer naturalist.

gingerm@wcnx.org
360-901-4469

WATER RESOURCES

Cary Armstrong has worked as a *Waste Reduction Specialist* at Clark County Water Resources for 4 1/2 years. He works with businesses and citizens in Clark County to help them reduce their impact on stormwater pollution.

Cary.Armstrong@clark.wa.gov
360-397-6118 ext. 4392

Pete Ritson currently works at the Environmental Information Cooperative. Seeing how we are damaging the environment, coupled with a love of teaching has drawn Pete to environmental education. He has taught and developed programs for middle school, high school, summer camps and college course covering areas of ecology, biology, chemistry, and earth science.

ritson@vancouver.wsu.edu
360-546-9510

ENERGY RESOURCES

Bruce Carter has worked as an *Energy Specialist* at Clark Public Utilities for about 2 years, doing public outreach and education on energy. He has also done energy research and education at Washington State University. Bruce has spent the last 20 years focusing on educating people about energy usage because he wants to see a better world for future generations.

bdcarter@clarkpud.com
360-992-3365 or 360-607-6860

Bob West has been at Clark Public Utilities for 24 years, doing work as an *Energy Councilor*. Bob goes into homes and businesses and teaches community members how to use energy efficiently. He enjoys educating people and improving society by encouraging wise energy use.

bwest@clarkpud.com
360-992-3362

OWNER'S MANUAL



PROGRAM OBJECTIVES:

Earth SAVER is an environmental education curriculum targeting middle school students, that focuses on protecting water, conserving energy and reducing waste. The Earth SAVER program, originally developed in 2001 by Clark County Department of Solid Waste, has evolved over the years but the mission of Earth SAVER has remained the same:

To encourage middle school students to conserve and protect the earth's natural resources through increased awareness of the resources that we use every day.

HOW EARTH SAVER WORKS:

The Earth SAVER program provides a unique opportunity for teachers and other professionals in the community to come together and make a difference. Earth SAVER stands for **Students Auditing and Verifying Efficient Resource use**. The program encourages students to take a hands on approach and use critical thinking skills to assess their daily use of natural resources. Earth SAVER staff working at Clark County, as well as experts from local utility companies and agencies who provide energy, water and waste management services will be available to assist teachers with Earth SAVER presentations and activities throughout the school year.

EARTH SAVER PROGRAM PARTICIPATION

Your participation in this program is truly making a difference by helping your school **save money and resources**. Furthermore, Earth SAVER is teaching students an ethic of resource conservation and encouraging the next generation to invest in their future. Thanks for acknowledging the importance of these programs by taking the time to include Earth SAVER in your busy schedules.

Clark County would like to reward your school for making an effort to conserve and protect the earth's natural resources that our community shares. Incorporating environmental education programs like Earth SAVER into your school's existing curriculum is essential in promoting ecological stewardship and responsibility. If teachers at your school meet the following requirements, your school will receive a **waiver on its stormwater fee**:

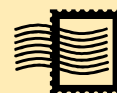


- 1) The program reaches 75% of students in the participating grade
- 2) The Introduction unit and activity is presented to students
- 3) All 3 lesson units, Material, Water and Energy Resources, are presented to students
- 4) A minimum of 3 activities, each from a different lesson unit, are completed by students
- 5) **Pre- and Post-Curriculum Surveys are completed by students and returned to Clark County Solid Waste so your school can be credited**

EARTH SAVER CONTACT INFORMATION

If you have any questions, wish to request an Earth SAVER curriculum or need to submit feedback and survey forms, please contact Sally Fisher at Clark County Solid Waste.

Sally.Fisher@clark.wa.gov
360.397.6118 ext. 4939



Earth SAVER Program
Clark County Solid Waste
P.O. Box 9810
Vancouver, WA 98666

USING THE EARTH SAVER CURRICULUM

The Earth SAVER curriculum is broken down into an **Introduction** and 3 lesson units:

1) Material Resources, 2) Water Resources and 3) Energy.

Cover page: A color coded cover page at the beginning of each of these 4 lessons provides general information about the units. A list of vocabulary words that are relevant to the lesson unit is included on the cover page and their definitions are given in the glossary (page 77). The overall goal of each unit is stated on the cover page and the main objectives are outlined there as well.

Student Outline Questions: A worksheet is included in each unit to lead students through the main points. You may have students fill in this worksheet during presentations to keep them engaged or use it afterwards as a test. These key questions are designed to get students thinking about the life cycles of natural resources. Questions revolve around a life cycle assessment framework, looking at how we use various natural resources, where these resources come from and what happens to these resources after we are done using them.

Main text: The objectives of each unit, outlined in the main text, should take approximately 45-60 minutes to present. The text is laid out to follow the questions on the student worksheet and is intended to be used as an outline for presentations. The text is written at a reading level appropriate for most middle school students, so you may also have students read or reference parts of the text. You may choose to present the material in the main text yourself or contact a guest speaker to assist with the presentation. If you decide to present the material yourself, the text should provide you with sufficient knowledge of each subject. If you wish to inquire more about certain issues, additional environmental education resources are cited on page 80.

If you are **interested in having a guest speaker** come into your classroom to present the material, **contact information** for these guest presenters are provided on page 6. Presenters are listed according to subject and a brief biography is also included to give you and your students general background information on each of the presenters.

Activities: In addition to the presentation that covers the content of the main text, each unit includes engaging activities that highlight various aspects of the unit. Guest speakers listed on the cover page of each unit may be available to assist with some of these activities as well. The activities emphasize and reinforce the main objectives of each lesson using hand on audits, interactive games, art and writing projects and worksheets.

THE TEACHER'S ROLE:

WORKING WITH GUEST SPEAKERS AND COMMUNITY MEMBERS

The Earth SAVER program requires a dedicated teacher. As a teacher, you play a critical role in the program's success. While guest speakers and professionals in the community may take on a teaching role during the program, it is your participation that ultimately determines what students will take away from Earth SAVER. You know your students needs better than any guest speaker possibly could so your collaboration with guest speakers is what makes this program work. To keep things running smoothly in the classroom we ask the following while guest speakers help out with presentations, activities and field trips:

- 1) Introduce guest speakers and remain present throughout the activity or lesson
- 2) Set and enforce standards for student behavior
- 3) Engage students and encourage active participation
- 4) Act as a role model for learning by asking guest speakers questions
- 5) Encourage students to thank the guest speaker for offering their time

PLANNING FOR EARTH SAVER

Working with the Earthsaver curriculum can take some planning, particularly if you want to invite guest speakers into your school or take your class on a field trip. Some activities may require communication with principals, custodians, parents and others involved with the school. The following steps will take you through the general planning process:

Getting to Know Earth SAVER: The first step in planning for Earth SAVER is familiarizing yourself with the program. First, please take the time to read through the **Owners Manual** so you understand the objectives, expectations and structure of the program, noting that the curriculum has been significantly restructured from past years.

Next, please read through the **lesson units** to inform yourself on the general issues addressed by the program so you can act as a reference to students. Also use this as an opportunity to seek out activities that you would like to include and determine which units you may wish to elaborate on. After looking over the program you should be able to provide students with a general outline of the program and set clear expectations about what they will learn. This may also help you determine how student performance and knowledge will be evaluated in your class.

Collaboration: Although teachers may work individually on the curriculum, it is typically more effective if teachers work together as a school. Working as a school usually allows more classes access to guest speakers and field trips. If you are working together with other teachers you should plan on getting together for an initial meeting **as early in the school year as possible** to voice your needs and determine what direction you want the program to go in.

Setting a Timeline: At the initial meeting you should begin putting together a rough timeline. The Earth SAVER program can be set up in two different ways. Your school may choose to set aside a single block of time (typically 1 or 2 weeks) to devote to Earth SAVER or to work the individual units into your school's existing curriculum. It is advised to schedule early in the year to avoid a pile up in the springtime.

Program Leader: Once a general timeline is decided upon, it works well to select one teacher, preferably someone who has past experience with Earth SAVER, to lead the program. The program leader should be someone willing to take on the following responsibilities:

- 1) Contact guest speakers and other community members to set up class presentations, activities and field trips.
- 2) Set up future planning meetings for teachers
- 3) Keep teachers up to date with current information
- 4) Assist in distributing supplies such as curriculum packets and student worksheets
- 5) Collect teacher evaluations and student surveys at the end of the program and return them to Clark County Solid Waste (address provided on page 8)

If new teachers are interested in Earth SAVER they should contact Clark County Solid Waste Department for a copy of the curriculum.

Guest Presenters and Field Trips: At the initial meeting teachers should discuss which guest presenters they wish to invite into the school and if they are interested in taking students on field trips. After setting a rough timeline that works with teachers, the program leader should contact the guest speakers to coordinate dates and set up a schedule.

Guest presenters should be contacted at least 3 weeks in advance and field trips should be planned at least 4 weeks in advance to schedule tours, reserve busses and get permission slips signed. Although these activities may take extra planning time, they are what makes Earth SAVER a great program and we encourage teachers to take advantage of the professionals in the community who can offer their expertise. **Clark County Solid Waste will provide funding for the West Van Transfer Station field trip** and we encourage teachers to schedule other related trips in conjunction to make the outing even more worthwhile. Please contact Clark County Solid Waste (see page 8) for more information.

PREPARING STUDENTS

Expectations: Before beginning the program you may want to take some time to briefly discuss the Earth SAVER curriculum with students and provide them with a general outline of the program. You may also want to set guidelines of your expectations about what students will learn from the program and determine how their performance and knowledge will be evaluated in your class.

Surveys: Before beginning the program, have students take the **Pre-Curriculum Survey**. This is intended to be an assessment tool and students should answer questions using their current knowledge. Please retain these surveys until the completion of the unit or program, have students complete the **Post Curriculum Survey**, and mail both surveys to Clark County Solid Waste.

Making Connections: You may choose to hand out the student's outline questions that follow each lesson after surveys are complete to introduce students to the Earth SAVER units that your class will be covering. If your students have studied components of these units earlier in the school year in their regular curriculum you may want to take some time to review the key points that they learned. This will give students a foundation to build upon in the upcoming units and help ease the transition. Additionally, you may have students read the lesson units before they are presented the information in class to give them a foundation for the presentation.

Earth SAVER PRE-Curriculum Survey Questions...

What do you know about the natural resources you use?



Name: _____

School: _____

Date: _____ Period: _____

MATERIAL RESOURCES:

- 1) What natural resources were used to make your lunch yesterday?
- 2) Where does our garbage go after it gets hauled away?
- 3) What can we do with the things we no longer want besides throw them in the garbage?

WATER RESOURCES:

- 1) Where does water in your faucet come from and where does it go after it flows down the drain?
- 2) When it rains at your school where does water from the roof and parking lots eventually go?
- 3) What are some ways we can prevent water pollution?

ENERGY RESOURCES:

- 1) When you turn on a light switch, what natural resources is the electricity generated from?
- 2) What are some costs that we pay for energy that don't show up on an electric bill?
- 3) What are some ways we can conserve energy?

Earth SAVER POST-Curriculum Survey Questions...

Now what do you know about
the natural resources you use?

Name: _____

School: _____

Date: _____ Score: _____

MATERIAL RESOURCES:

- 1) What natural resources were used to make your lunch yesterday?
- 2) Where does our garbage go after it gets hauled away?
- 3) What can we do with the things we no longer want besides throw them in the garbage?

WATER RESOURCES:

- 1) Where does water in your faucet come from and where does it go after it flows down the drain?
- 2) When it rains at your school where does water from the roof and parking lots eventually go?
- 3) What are some ways we can prevent water pollution?

ENERGY RESOURCES:

- 1) When you turn on a light switch, what natural resources is the electricity generated from?
- 2) What are some costs that we pay for energy that don't show up on an electric bill?
- 3) What are some ways we can conserve energy?

INTRODUCTION

GOAL:

Students will be introduced to some fundamental ecological themes including interdependence, sustainability, conservation and adaptation. Students will explore these essential concepts that will be echoed in upcoming lessons, through an interactive game in order to gain a deeper understanding of sustainable resource use.

DURATION:

30-45 minutes

VOCABULARY:

adaptation
conservation
ecosystem
impact
interdependence
natural resource
nonrenewable resource
perpetual resource
renewable resource
sustainability
wildlife habitat

MATERIALS:

Earth SAVER Key Concepts

OBJECTIVES:

- 🌍 Describe the concept of interdependence
- 🌍 Understand the concept of sustainability and the role that conservation plays in sustainable resource use
- 🌍 Distinguish between renewable, nonrenewable and perpetual resources
- 🌍 Describe the importance of adaptation as it relates to natural resource use and sustainability
- 🌍 Increase awareness of the resources that are used each day at home and at school
- 🌍 See that the Earth SAVER program is fun!

EALR CONNECTIONS:

Reading

- 1.2 • *build vocabulary through reading*
- 2.1 • *comprehend important ideas and details*
- 3.1 • *read to learn new information*

Communications

- 1.1 • *focus attention*
- 1.2 • *listen and observe to gain information*

Science

- 1.1 • *properties of substances*
- 1.2 • *systems*
- 1.3 • *life processes and the flow of matter and energy*
- 1.3 • *interdependence of life*
- 1.3 • *environmental and resource issues*
- 2.2 • *identifying problems*

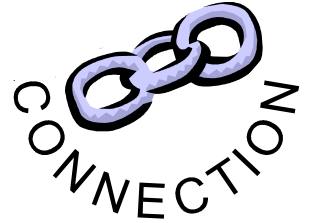
Geography

- 3.1 • *identify and examine people's interaction with and impact on the environment*
- 3.2 • *analyze how the environment and environmental changes effect people*





1. What is **interdependence**?



2. What is **sustainability**?



3. What is **adaptation**?



CHANGE

What is Interdependence?

Interdependence is the concept that different elements in a system interact and depend on each other. Earth, as an **ecosystem**, follows this law of interdependence. All of the elements in our earth system that may seem separate, such as fish, trees, water and humans, are in fact connected through a complex and delicate web of life.

Every action that these individual elements in the system has, can **impact** other elements positively or negatively. This concept is important to understand when studying about the earth because if one element in the system is not in balance, the entire system, or environment, will be out of balance.

What is Sustainability?

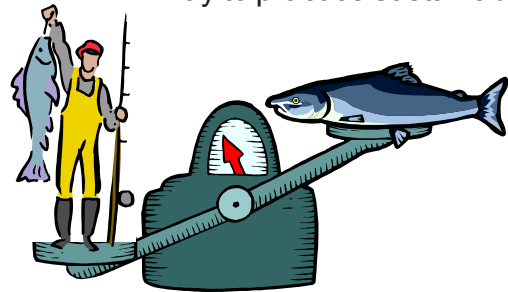
All living things require a continuous supply of untainted **natural resources** to meet their needs for life. Natural resources are materials that are supplied by the environment and used to fulfill our needs and wants. In order to sustain our life, we must have access to certain natural resources for food, water, clothing, shelter, etc. **Sustainability** is the ability to meet our needs without depleting these natural resources or damaging the systems that supply them.

Some natural resources cannot replenish themselves naturally. We call these type of natural resources **nonrenewable resources**. Nonrenewable resources exist on earth in fixed amounts and their formation takes hundreds of millions of years and/or very special circumstances. As we use nonrenewable resources, their abundance decreases. If we continue to use these resources, they will eventually be completely depleted; once they are used there is no way of getting them back. Because nonrenewable resources cannot be replenished, there is no way to use them sustainably.

Many natural resources are able to replenish themselves through natural cycles. These natural resources, known as **renewable resources**, can be used sustainably if we use them wisely. For example, fish are able to reproduce and renew themselves over a relatively short period of time, so even while we use them as a food resource, they can regenerate. Because fish can replenish their supply naturally, it seems logical to think that there will always be fish around.

But, if we were to catch fish faster than they can reproduce, we would eventually run out of fish. Or, if we damage the **wildlife habitat** where fish live, they would also not be able to survive. If we threaten the ability for fish or any other natural resource to renew itself through a natural cycle, we are not using this resource in a sustainable way. The key to sustainability is finding a balance between using a natural resource and allowing time for it to naturally renew itself.

Some natural resources are available in a virtually infinite supply and they are replenished naturally without necessarily following a cycle. These natural resources are sometimes called **perpetual resources** because they typically continue without interruption and last for an indefinitely long period of time. Human use of perpetual resources, such as the sun or wind, has little or no effect on their abundance. Using perpetual resources to meet our needs is one way to practice sustainability.



BALANCE

What is Adaptation?

Adaptation is the ability of organisms to respond and develop in response to changes in their environment. Physical adaptations such as developing wings or gills can take hundreds of centuries, but some adaptations, like changing our behavior, can happen over night.

The ability to adapt by changing our behavior or actions plays an essential role in survival and can be a key in achieving sustainability. If we are using a natural resource in an unsustainable way, we may need to make some changes so that we can continue to get our life needs met. For example, if we are harvesting trees for lumber faster than trees can grow, we may need to practice **conservation**. Conservation is a way of slowing down and carefully managing natural resources, so they are preserved for the future.

In other cases we may change which natural resources we use. For example, coal and wind are two natural resources that can be used to generate electrical energy. In the United States we generate most of our electricity from coal, but coal is a nonrenewable resource. If we continue to use coal, we will run out of it one day, so we have no way of using it sustainably. As a sustainable alternative, we could choose to generate more electricity using wind, since it is a perpetual resource.

Adaptation, the ability to change, is where each of us can make a difference in the world. Because we are all interconnected, a small change in behavior by a single individual or group of people can have an impact on the larger system. When we decide to recycle a sheet of scrap paper, we are protecting forest habitats where animals live. When we ride our bikes instead of jumping in the car, we are helping to prevent a local stream from being contaminated with motor oil. When we decide to turn off a light while leaving a room, we are choosing to reduce air pollution and help save the lives of salmon in our rivers.

RESOURCE CONSERVATION QUOTES

"When one tugs at a single thing in nature...he finds it attached to the rest of the world."

-John Muir

*"The purpose of conservation:
The greatest good to the greatest number
of people for the longest time."*

-Gifford Pinchot



CHANGE

*"Only after the last tree
has been cut down.
Only after the last river
has been poisoned.
Only after the last fish
has been caught.
Only then will you
find that money
cannot be eaten."*

-Native Cree Prophecy

*"Never doubt that a small group of thoughtful,
Committed citizens can change the world.
Indeed its the only thing that ever has."*

-Margaret Mead

*"We abuse the land because we regard it
as a commodity belonging to us.
When we see land as a community
to which we belong,
We may begin to use it with love and respect."*

-Aldo Leopold

*"A true conservationist is a man who knows
that the world is not given by his fathers,
but borrowed from his children."*

- John James Audubon

TAKE IT AS IT COMES?

OVERVIEW:

Students engage in a class demonstration to learn first hand about the concepts of sustainability and conservation as they pertain to natural resource use.

DURATION:

Activity: 10-15 minutes

Follow-Up: 10-20 minutes

VOCABULARY:

adaptability

conservation

natural resource

nonrenewable resource

perpetual resource

renewable resource

sustainability

MATERIALS:

pretzels or popcorn

natural resource cards

Take It As It Comes

*What A Different World It
Would Be*

OBJECTIVE:

Students will understand that there are environmental and social costs associated with using natural resources. They will see that these resources need to be carefully managed in order for them to be available for future generations and to protect the environment from degradation.

EALR CONNECTIONS:

Science

1.1 • *nature and properties of earth materials*

1.1 • *basis of biological diversity*

1.2 • *systems*

1.3 • *life processes and the flow of matter and energy*

1.3 • *interdependence of life*

1.3 • *environmental and resource issues*

2.1 • *communication*

2.2 • *identifying problems*

Geography

3.1 • *interaction with and impact on the environment*

3.2 • *environment and environmental changes affect people*

Communication

1.1 • *focus attention*

3.2 • *work cooperatively as a group*

3.3 • *seek agreement and solutions through discussion*

Arts

2.2 • *generate and analyze solutions to problems using creativity and imagination*

4.1 • *use art skills and knowledge in other subject areas*

PROCEDURE:

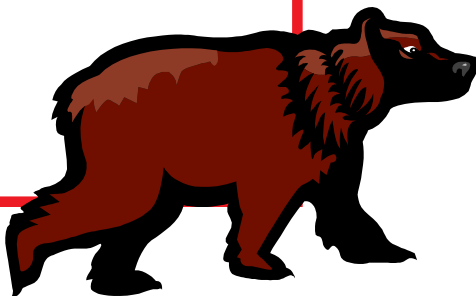
SETUP

1. Divide students as evenly as possible into 8 groups and assign a natural resource card to each group. Hand out one ***Take It As It Comes*** worksheet per group and have them set it aside to complete later in activity.

INTRODUCTION

1. Distribute 3 pretzels to each student and instruct them to combine their pretzels into a single group pile. Tell them that these pretzels represent the natural resource that they have been assigned, which they depend on for survival.

2. Explain the object of the game: This is a game about using natural resources. We will play 5 rounds of the game. The object of the game is to survive through all 5 rounds by consuming the resource that your group depends on.

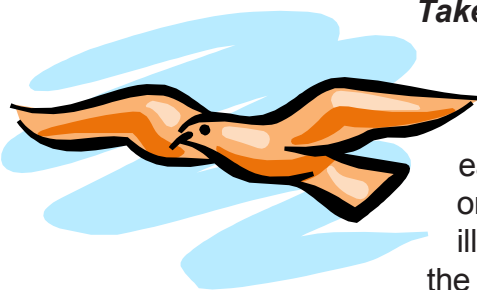


3. Next explain the rules of the game: There are 3 simple rules that must be followed...

1) Each round every student must consume at least one whole pretzel (no breaking, stashing or sharing) to survive into the next round. Students can eat freely from the pile but must eat a *minimum* of one pretzel.

2) At the end of each round the instructor will replenish the natural resources based on what type of resource each group has. This means that some groups may get more pretzels than other groups.

3) At the end of 5 rounds each group is allowed to eat what is left of their pretzel pile.



DOING THE ACTIVITY

1. Begin round one, allowing students to consume their resources freely. After a group is satisfied with their consumption have them count their remaining “resource” then indicate that they are ready to move on. The instructor will then replenish pretzel supplies based upon the type of resource that each group has:

Renewable: Replenish resource supply by half of the existing amount. Some natural resources that may be considered renewable include animals, plants, fertile soils, trees and water.

Non-Renewable: Do not replenish. Some nonrenewable resources may include coal and oil.

Perpetual: Replenish heavily no matter how much of the supply remains. The sun can be considered to be perpetual.

2. Continue in this fashion through 5 rounds.

FOLLOW-UP

1. Allow 5 to 10 minutes for each group to complete their worksheet, providing assistance if needed.

2. After completion have each group share with the class what their natural resource is and what type of natural resource they decided their group has. Use this as an opportunity to discuss the definitions of **renewable**, **nonrenewable** and **perpetual resources**.

3. Continue to go through the questions on the **Take It As It Comes** worksheet. Discuss these questions as a class and be sure to cover the definitions and concepts of the highlighted words in each question. It may work well to focus on different natural resource groups for illustrating different concepts. Draw on the different experience that each group had during the activity so that students can learn from one another.

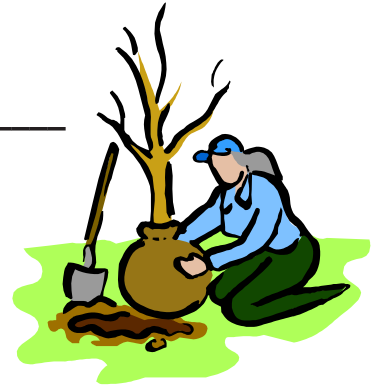
4. Conclude by examining why is it important to conserve natural resources and use them sustainably. You may want to share the list of **Resource Conservation Quotes** with students.

5. Finally, have students break out of their groups and complete the **What A Different World It Would Be** worksheet, reflecting on their experience during the activity. You may have them write a short story to go along with their illustration.

TAKE IT AS IT COMES?

Name: _____

Natural Resource: _____



1. What **type** of natural resource does your group have? (circle one)

Renewable

Non-Renewable

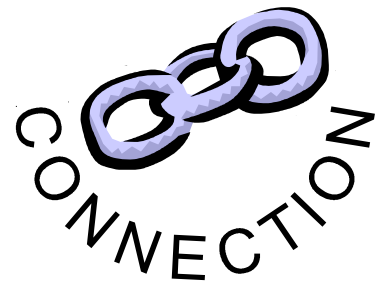
Perpetual

2. What do you **need** or **want** this natural resource for? Could you **survive** without it?

3. Were you able to use this natural resource in a **sustainable** way? Why or why not?



4. Since everything in our ecosystem is **interdependent**, how could using this natural resource **impact** other elements (plants, air, humans, animals, water, etc.) of the Earth?



5. What are some ways you could **adapt** if you began to run out of this natural resource or if using it caused harm to other elements in our ecosystem?

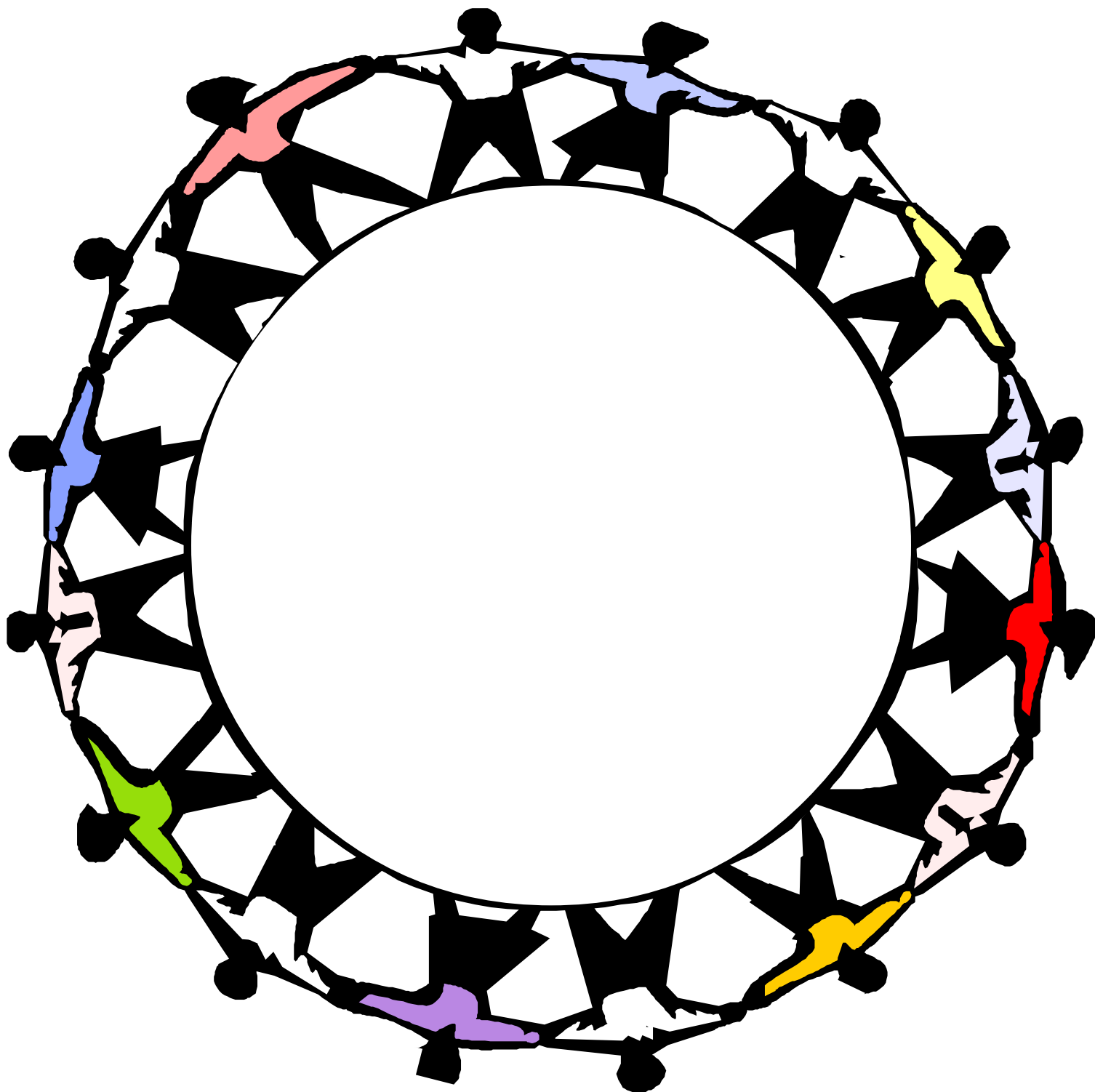


CHANGE

WHAT A DIFFERENT WORLD IT WOULD BE

Name: _____

Directions: Think for a minute about a natural resource that you either need to survive or that you enjoy having around. Now, draw a picture of what you think our world would be like if this natural resource was no longer available for us to use.



1: MATERIAL RESOURCES

GOAL:

Students will gain an understanding of the ways that humans impact the environment through natural resource consumption and waste generation. Learning about the connections between consumer choices and our ecological footprints, students will become empowered with the ability to make simple behavior changes that lessen our environmental impact.

DURATION:

45-60 minutes

VOCABULARY:

Central Transfer & Recycling
compost
bailer
decomposition
ecological footprint
Finley Buttes Landfill
hazardous waste
impermeable
leachate
manufactured goods
materials recovery facility
microorganisms
organic
recycling
recycling market
remanufacture
sanitary landfill
solid waste
sort line
transfer station
vermicomposting
virgin materials
Waste Connections
Waste Management
West Van Transfer Station
yard debris

MATERIALS:

Material Resources
Outline Questions

OBJECTIVES:

- ▲ Increase awareness of the material resources that we use in our daily lives
- ▲ Understand what happens to the material resources that we dispose of as waste
- ▲ Recognize the natural resources, energy and labor that are needed to produce material things
- ▲ Explain why it is important to conserve natural resources and recommend ways to reduce our ecological footprints
- ▲ Recognize the need for and determine alternatives to solid waste disposal
- ▲ Describe the general process and gain an understanding of the benefits of recycling

EALR CONNECTIONS:

Reading

- 1.2 • *build vocabulary through reading*
- 2.1 • *comprehend important ideas and details*
- 3.1 • *read to learn new information*

Communications

- 1.1 • *focus attention*
- 1.2 • *listen and observe to gain information*

Science

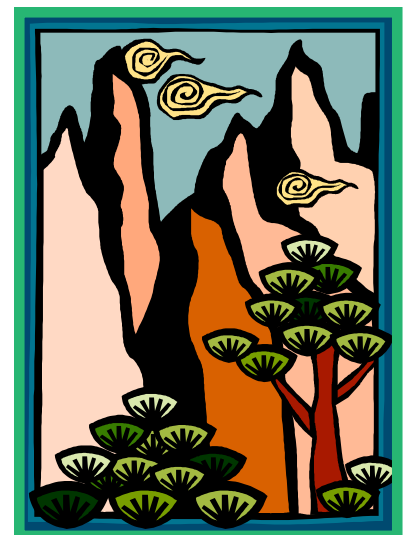
- 1.1 • *properties of substances*
- 1.2 • *systems*
- 1.3 • *life processes and the flow of matter and energy*
- 1.3 • *interdependence of life*
- 1.3 • *environmental and resource issues*
- 2.2 • *identifying problems*

Health

- 3.1 • *understand how environmental factors affect one's health*

Geography

- 3.1 • *identify and examine people's interaction with and impact on the environment*
- 3.2 • *analyze how the environmental and environmental changes effect people*



3. How are the things that we buy and use each day produced?

4. How can we reduce our use of natural resources?

REDUCE

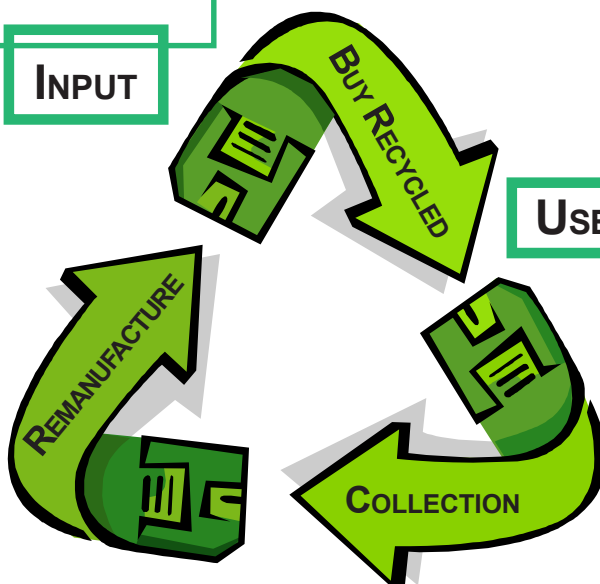
1. What kinds of material resources do we use everyday?

INPUT

6. How can products we no longer want be recycled?

USE

RECYCLE

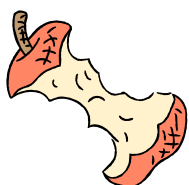


OUTPUT

2. What happens to the things we throw away?

REUSE

5. How can we reuse the things we already have?



1. What kinds of material resources do we use everyday?

As citizens of the United States, we consume many things. In fact, if every person living on earth consumed as many natural resources as the typical American does, we would need more than 5 Earths worth of natural resources to support our consumption. All of the material things around us come from natural resources supplied by the earth. It is easy to identify the natural resources that we are using when products have little or no manufacturing. We can see that tomatoes come from plants and that the wood on a skateboard deck comes from trees. Often times, though, it's difficult to know where the things that we surround ourselves with come from because the natural resources have been manufactured into entirely new products. For example, we may not know that our T-shirt could be made from petroleum or that our glass juice bottle is made from sand.

2. What happens to the things we throw away?

Every day each of us decides when the products that we use are no longer valuable to us. A product may lose its value to us if it wears out, goes out of style, is used up or becomes outdated. Usually when we stop seeing the value of our possessions we no longer want them around so we throw them away. Because we consume many things, we produce a lot of waste. Americans make up only about 5% of the world's population but produce 30% of the world's garbage. What happens to all of our things once we decide to throw them away?

Solid Waste

In Clark County, residents can pay to have their **solid waste**, or garbage, picked up at the curb and hauled away by one of two different waste companies, **Waste Connections** and **Waste Management**. These companies haul our solid waste to the **Central Transfer & Recycling** or **West Van Transfer Station**. Some house-

holds, schools and businesses choose to haul their own solid waste to the transfer station. The **transfer station** is often called the dump, but in reality nothing that goes to the transfer station is dumped in the ground; everything is transferred out. At the transfer station, the garbage is compacted into 40 foot-long containers which are loaded onto barges at the Port of Vancouver. These barges take about 160 containers packed full of Clark County's garbage 160 miles up the Columbia River each week to a **sanitary landfill** near Boardman, Oregon. The garbage is spread out and compacted in **Finley Buttes Landfill**, then covered with soil to decrease the odor and prevent rodents, birds and insects from scavenging and possibly spreading diseases.

Finley Buttes is located in Eastern Oregon because it is not a densely populated area and the climate is quite dry. Locating a landfill in dry areas helps protect the environment and people by preventing contaminated water or **leachate** from leaking out of the site and getting into the soil or aquifers. Sanitary landfills are specially constructed with many bottom layers to create an **impermeable** liner that prevents groundwater contamination. Finley Buttes Landfill is lined with layers of clay, filter fabric, plastic and other material to contain leachate. There are also collection pipes and ponds to catch and treat leachate. Before sanitary landfills were built, garbage was dumped into unlined landfills and sometimes even stream beds, often causing water pollution in streams and aquifers.

Once material is in a landfill, it is usually buried forever. Since there is very little air circulation in landfills, garbage decomposes very slowly and some material does not break down at all. Scientists studying solid waste have found 50 year old newspapers that can still be read and apples that are still crisp at the bottom of landfills. Each one of us produce about 7 pounds of waste every day. When we "throw away" our possessions and send this waste to the landfill it does not go away, but keeps adding up.

Hazardous Waste

Many of the products that we use everyday contain chemicals or materials that are very harmful if they are released into the environment. These materials need to be handled in a special way and are treated as **hazardous waste**. Many things that are treated as hazardous wastes are commonly found in our homes. Used motor oil, paint, batteries, household cleaners, chemical fertilizers, pesticides, and herbicides are a few examples of household hazardous waste. Even electronics like televisions, computers, fluorescent light bulbs, cell phones and mercury thermometers contain heavy metals and vapors which are toxic to humans and the environment.

Hazardous waste does not go away, but proper disposal of these products can decrease the risk of toxins getting into the environment. Hazardous waste does not belong in trash cans, down drains, in storm drains or in the ground. These items need to be taken to special hazardous waste facilities, like the transfer station. At the transfer station, hazardous waste can be handled carefully to reduce the risk of exposing the workers to health dangers and to keep the toxins out of the soil and water.



3. How are the things that we buy and use each day produced?

The products that we use each day have life cycles similar to living things. Products are created (born), used (live) and then typically disposed of (die). Sometimes we use natural resources in their natural state, but the majority of the things that we surround ourselves with are **manufactured goods** like jeans, potato chips, video games and cars.

Components

Most of the goods we consume have a very complicated life cycle because they are made of several components. The first step in understanding this life cycle is recognizing all of the various components that make up a product. For example, if we purchase a cheeseburger at a fast food restaurant, we are actually buying a meat patty, cheese, a bun, ketchup, mustard, onion, pickles, packaging and the energy that went into preparing each component.

Natural Resources

Once we separate out the components of a product, we can look at the natural resources that went into each of these components. Taking a closer look at the cheese, for example, we learn that milk is used, which comes from a cow, which produces milk by eating grain, which is grown with sunlight, soil and water.

Manufacturing Process

Next we need to look at the manufacturing processes needed to turn these natural resources into the final product. Manufacturing processes may require more natural resources as well as other resource inputs such as energy, labor and machinery. Looking even closer at cheese, we may learn that many pesticides and fertilizers were used on the grain that fed the cow, that steel was mined for the factory's machinery, that labor from farmers and factory workers was needed, and that salt was milled to add to the cheese.

Transportation

Most of the products we buy travel far before reaching our homes, requiring additional inputs of resources (trucks), energy (gas) and labor (drivers). These inputs are needed to transport natural resources to factories, to transport components to assembly plants, to transport products to packaging plants, to transport the final product to stores and to transport the product to our homes. The natural resources, energy and labor that went into making cheese may have come from many parts of the world. In fact, every bite of food the average American takes has traveled about 1,200 miles.

Footprints

Each of these steps involved in producing and transporting a product leaves a footprint upon the earth. The environmental impact that is left behind is known as an **ecological footprint**. The coal we use to produce energy for the machinery, the trees we harvest for packaging, the oil we drill for transportation and the chemicals we spray on our crops contribute to water and air pollution, the loss of wildlife habitat, and global warming. The good news is as individual consumers we have the choice to decrease our personal ecological footprints by making wise choices and remembering to follow the guidelines of reduce, reuse and recycle.

4. How can we reduce our use of natural resources?

Downsize

One of the simplest ways we can reduce the amount of natural resources we use is by using fewer things. It's important to consider the size of a footprint that we leave behind when we use natural resources. If we do simple things like use both sides of a piece of paper we can cut this footprint in half. In our culture it's common to think that bigger is better, but buying more usually means impacting the earth more. Everybody needs certain material things to survive and to be healthy, but evaluating our needs and our wants is a good way to start reducing the amount of natural resources we use and the amount of waste we generate. We can also decrease our footprints by making smart choices when we do choose to buy something new.

Packaging

Many of the products we buy contain more packaging than necessary. Some companies use excessive packaging for advertising as well as for protecting the product. Packaging often uses more natural resources and creates more waste than the product itself does. Because packaging impacts the environment, when we make purchases, it's important to consider if we are buying a great product or the great container in which the product is packaged.

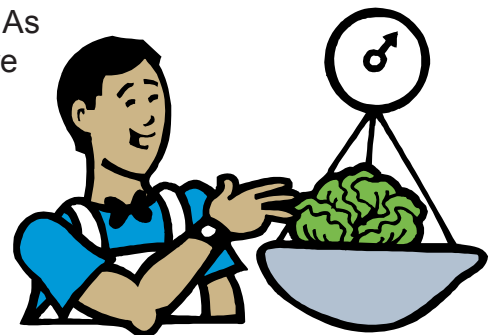
Buying products with less packaging reduces waste and saves natural resources as well as money. Usually we have an option to buy a similar product without all the fancy and wasteful packaging. For example, buying food in bulk is an easy way to reduce packaging by avoiding the box or bag that the product might otherwise come in. You can also reduce packaging by choosing items that come in their own natural packages, like bananas and oranges.

Hazardous Waste

Choosing products that are nontoxic may not reduce the overall amount of waste we create, but it is one easy way to reduce our hazardous waste. Reducing hazardous waste is an important way to protect the environment, wildlife and our own health. Hazardous waste comes from products that are made with materials that are harmful in the environment.

We often have the option to select products that are safer alternatives to the products that produce hazardous waste. For example, there are many household cleaners that are nontoxic and just as effective at cleaning up messes as cleaners containing chemicals that are harmful to human health and the environment. These products may cost less money as well. We may also choose to add compost to our plants in place of chemical fertilizers to prevent water contamination and wildlife habitat destruction.

Many of the products that we buy may not be hazardous themselves, but hazardous chemicals may have been used in their production. For example, most food is grown using chemical fertilizers, pesticides and weed-killers. These chemicals are harmful to the environment and the farm workers who are around the chemicals daily. As an alternative, we may choose to buy **organic** produce that is grown without the use of these chemicals.



5. How can we reuse the things we already have?

Disposables

Buying products that are disposable uses a lot of natural resources and creates a lot of waste. Every day more products are stocked on store shelves that are disposable. As a result, each of us are producing more and more waste each year. Luckily there are alternatives to all of these disposable products that we can reuse. Trees are one natural resource that is impacted by disposables. Just eating lunch, our choices can save trees. We can replace paper plates with ceramic plates, paper towels with cloth towels, paper cups with glasses, paper napkins with cloth napkins, and paper bags with a lunch box.

Compost

One great way to reuse food scraps, rather than waste them, is by creating a compost pile. When **organic** matter such as leaves, plants and animals die, the materials decay. Insects and **microorganisms** break down the dead material through a natural process called **decomposition**. **Compost** is a mixture of this decomposed organic matter. We can create this natural process in our own backyards by collecting organic matter such as vegetable scraps, grass clippings, coffee grounds and egg shells in a compost pile and allowing it to decompose. **Vermicomposting** uses red worms to help digest fruit and vegetable scraps. The vermicomposting process can decompose kitchen scraps faster than a standard compost pile and it produces a more nutrient-rich soil additive.

Compost helps reduce natural resource use and helps protect the environment in several ways. Compost is a free, natural and nutrient-rich fertilizer. It adds nutrients to soil and allows soil to hold more water. Compost helps vegetables, flowers, trees and grass grow naturally without adding potentially harmful chemical fertilizers or having to water as often. Compost

can even prevent insects from damaging plants. This decreases the need for dangerous pesticides and also lets beneficial insects live. One of the biggest benefits of composting is it greatly reduces the amount of garbage that goes to the landfill. In fact, 40% of our waste could be completely eliminated by composting. This would save space in landfills and save you money because you don't have to pay to have as much garbage hauled away.

Yard Debris

Yard debris, such as leaves, twigs and grass clippings can be brought into a transfer station where it is heaped into large piles. Much like backyard composting, these piles decay over time and produce a very nutrient-rich fertilizer. Some customers choose to have their yard debris collected curbside. Yard debris is picked up by a private company. They grind up the material, compost it and sell the rich mulch. Many communities, including Clark County, have yard debris collection services.

Donations

If you've ever gone to a transfer station or landfill, you have seen that there are countless treasures among the trash. Televisions, toys, couches and stuffed animals are some of the things you may see that somebody no longer wanted. Many of these items that people throw away can be donated to charities or passed on to a friend. Even products like egg cartons or milk jugs may be donated to schools to be used in art projects.

6. How can products we no longer want be recycled?

Waste Connections and Waste Management also provide a curbside recycling service to residents in Clark County. A recycling truck with specialized compartments is used to pick up presorted recyclable materials and hauls them to the West Van Transfer Station. Half of this transfer station is actually a **materials recovery facility** or **MRF** (pronounced merf).

At the MRF, recyclables are sorted further into piles as they pass through a **sort line**. The sort line consists of a series of conveyor belts which move the recyclables past workers who hand sort most of the items. Magnets also assist in sorting the items made of steel by pulling them off of the conveyor belt. After they are sorted, most of these materials go through a **baler** machine where they are packed tightly together and bound with strong wire to form bales.

The bales are loaded onto trucks that deliver our recyclable materials to various **recycling markets** around the world. These recycling markets buy recyclables and use the materials to make new products because it is often cheaper to **remanufacture** materials than to use **virgin materials**.



RECYCLING MARKETS

Mixed Waste Paper and Newspaper is packed loosely into trucks and sent to local paper mills in Washington and Oregon. At the mill the paper is shredded, mixed with raw pulp from trees and made into newsprint. Mixed waste paper that is collected curbside on Monday in Clark County can be back on your doorstep by Friday as your local newspaper! Some old newspaper is manufactured into insulation in Portland.

Milk Cartons and Drink Boxes are baled separately, sent to local mills and incorporated into cardboard or other paper products.

Steel or “Tin” Cans are lifted off of the sort line using a large electromagnet. The cans are then baled and sent to steel plants to be melted down and made into new steel products such as car parts and construction materials.

Corrugated Cardboard is separated by hand, baled and sent to area mills for remanufacture into new cardboard.

Aluminum Cans are separated mechanically, baled, and sent to aluminum plants. The metal is melted down, pressed into bars or sheets and made into new aluminum products, like soda cans. This is one of the easiest and most efficient materials to recycle so most aluminum cans we buy are made from 50% recycled aluminum. Aluminum can be remanufactured into bicycle frames and even airplanes.

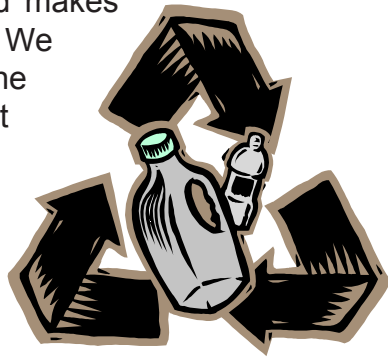
Glass Bottles and Jars are color separated by hand and sent to a glass manufacturer in Portland. You can see the piles of glass at the factory just west of I-205 and south of the exit for Portland International Airport. They are melted down, mixed with raw quartz sand and made into new glass bottles and jars. Window glass, ceramics, light bulbs, glass cookware, and drinking glasses are made of glass that melts at different temperatures so it cannot be recycled with glass bottles and jars. Broken glass can be crushed and use like sand or gravel in concrete to pave roads.

Plastic Bottles are separated by the type of plastic, formed into bales and sent to markets in Canada and China. At some factories plastic soda bottles are ground up and melted down to produce strong plastic threads. These polyester threads can easily be recycled into carpet fibers, T-shirts, fleece jackets, and sleeping bag filler. Other markets remanufacture different types of plastic bottles, like laundry soap bottles, into new plastic products like toys.

Chipboard such as cereal boxes and boxes for 12-pack cans of soda, is separated by hand from the mixed paper, baled, and sent to local paper mills where it is pressed into new paper products like egg cartons.

The Recycle Symbol

The recycle symbol, made up of three chasing arrows, is commonly understood to represent the three Rs: Reduce, Reuse and Recycle. Actually, the symbol was originally designed to represent Collection, Remanufacture, and Buying Recycled. These are the steps in the recycling process. First, recyclable materials must be collected so they can get sorted and shipped to various markets. Next, at the various markets the products are remanufactured into new products. And finally, after new products are made from the recycled materials, they are sent to stores where they can be sold. Selling the remanufactured goods and buying these products with recycled content is one of the most important steps in this cycle because it closes the loop and makes recycling possible. We can all help close the loop by seeking out and requesting products made with recycled materials.



Recycling matters

A tremendous amount of natural resources, energy, money, wildlife habitat and landfill space can be saved just by recycling. The choices we make each day can really make a difference. Each time you choose to use paper with recycled content, then recycle that paper, you are allowing trees to remain standing and preventing water pollution. Each time you toss a plastic soda bottle into the recycling bin you are eliminating the need to drill for more petroleum and saving wildlife habitat. Plus, it costs more money to fill a garbage can than to fill the same sized container with recyclables. In fact, in 1998 Vancouver schools saved nearly \$30,000 in disposal fees just by recycling. In 2000, recycling in Clark County kept over 28,000 tons of material out of the landfill.

RECYCLING MAKES A DIFFERENCE

One recycled **aluminum** can save enough energy to power a 100-watt light bulb for 20 hours.

About 40% of Washington's waste stream could be **composted**

Recycling one ton of paper saves 17 **trees** and 380 gallons of **oil**

Recycling glass bottles reduces **mining waste** by 80%, water use by 50%, and air pollution by 20%

Plastic soda bottles can easily be recycled into carpet fibers, **T-shirts**, fleece jackets, and sleeping bag filler

Recycling **paper** reduces air pollution by 74% and water pollution by 35%

Recycling aluminum saves 95% of the energy need to make aluminum from bauxite ore and reduces **air pollution** by 95%

You and every other **American** uses an average of 580 pounds of paper each year

Recycling **plastic bottles** saves 90% of the energy needed to produce new plastics

Recycling **glass** saves 32% of the energy needed for the production of new glass

Over **500,000** trees are used each week to supply Americans with a Sunday newspaper

WATCH WHERE YOU STEP

OVERVIEW:

Students look into the life cycle of a soda to gain a deeper understanding of the diverse natural resources that are required to produce this single product. Students then take this insight and apply the reflection process to a product of their choice in small groups, outlining the ecological footprint that we make when we use various products.

DURATION:

Activity: 30 minutes
Follow-up: 30 minutes

VOCABULARY:

ecological footprint

MATERIALS:

36 Ecological Footprint
story cards
butcher paper

OBJECTIVE:

Students will learn to look more deeply at the products that they use and gain an appreciation for the energy, labor and resource-intensive processes that go into these products.

EALR CONNECTIONS:

Reading

- 1.2 • *build vocabulary through reading*
- 2.1 • *comprehend important ideas and details*
- 3.1 • *read to learn new information*

Communications

- 1.1 • *focus attention*
- 1.2 • *listen and observe to gain information*
- 2.3 • *use effective delivery*

Science

- 1.2 • *systems*
- 1.3 • *life processes and the flow of matter and energy*
- 1.3 • *interdependence of life*
- 1.3 • *environmental and resource issues*
- 2.2 • *identifying problems*

Health

- 3.1 • *understand how environmental factors affect one's health*

Geography

- 3.1 • *identify and examine people's interaction with and impact on the environment*
- 3.2 • *analyze how the environment and environmental changes effect people*

PROCEDURE:

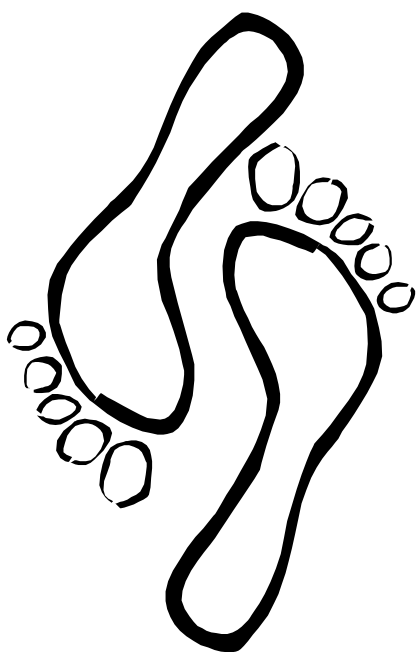
SETUP

1. Let students know that they will be looking closely at the life cycle of a can of soda and learning about the concept of an ecological footprint.
2. You may briefly explain the concept of a footprint before the activity if your students are unfamiliar with the idea. An ecological footprint looks at the impact that a single activity has on the earth, in terms of environmental and social costs.



DOING THE ACTIVITY

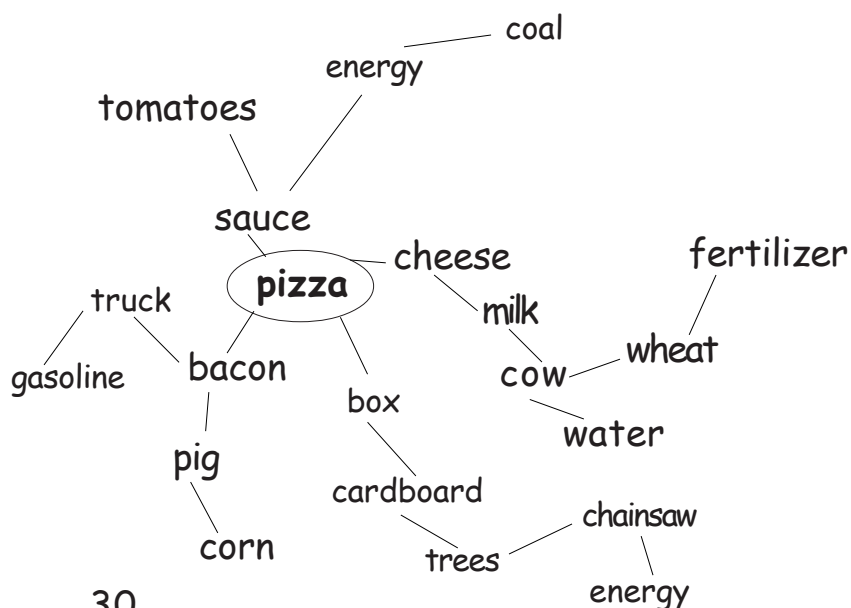
1. Randomly distribute the story cards to students making sure each student receives at least one card. Some students may receive more than one card depending on class size. Students may wish to take a minute to read over their card.
2. The first and last cards are not numbered. They both have a picture of soda pouring from a can. The first card reads, "How much does a can of soda cost?" Present this first card yourself, asking students how much money they typically pay for a can of soda. Once a general consensus is reached, write this figure on the board and ask students if they think this is a reasonable price.
3. Call upon the student with card number one to begin reading. Have students read the cards in the order that they are numbered. You may have students come to the front of the room to read their card and remain standing, creating a circle as more cards are read. This will not work if there are more cards than students. If this is the case you may choose to have students stand at their desks to read, show the picture and sit back down.



4. After all the cards have been read, read the last card yourself, encouraging students to reflect upon the impacts associated with producing their can of soda. Call upon students to hold up the cards that represent various environmental and social impacts such as habitat destruction, water pollution, global climate change and health problems. As each group holds up cards ask students how much clean air, health and wildlife is worth to them. Does the cost of a can of soda pay for these impacts?

FOLLOW-UP

1. You may have students work in groups to continue the discussion of ecological footprints. Have students select a popular food item and map out the ecological footprint for this product on a large sheet of butcher paper. Encourage students to draw pictures or perhaps make a collage and include as many resources as they can think of on their maps.
2. When maps are complete have students brainstorm some of the ways that we can decrease the impact of this footprint. Some ideas may include buying locally grown foods, reducing unnecessary packaging, supporting organic farmers, consuming less processed foods, reducing meat and dairy intake, etc.



THE GOOD, THE BAD, THE SMELLY

OVERVIEW:

Students take a professional tour the West Van Transfer Station, seeing first hand what happens to our garbage, recycling, yard debris and hazardous waste once it leaves our homes and schools. This behind the scenes tour provides a very impressive visual (among other senses) for understanding just how much waste we generate.

DURATION:

Tour: 60 minutes

Follow-up: 30-50 minutes

VOCABULARY:

bale
baler
barge
compost
conveyer belt
decompose
electromagnet
hazardous waste
organic
solid waste
sort line
transfer station
yard debris

MATERIALS:

Wasted Words
Scavenger Hunt
clip boards or other hard
writing surface

OBJECTIVE:

Students will gain an understanding of the fact that our waste does not just go away when we throw it away, but continues to add up. They will learn about the intensive process that recycling and waste go through after it leaves our hands.

EALR CONNECTIONS:

Communication

- 1.1 • *focus attention*
- 1.2 • *listen and observe to gain and interpret information*

Science

- 1.1 • *properties of substances*
- 1.3 • *life process and the flow of matter and energy*
- 1.3 • *environmental & resource use*
- 2.2 • *identifying problems*

Geography

- 3.1 • *identify and examine people's interaction with and impact on the environment*

Health

- 2.3 • *acquire skills to live safely*
- 3.1 • *understand how environmental factors affect one's health*

PROCEDURE:

SETUP

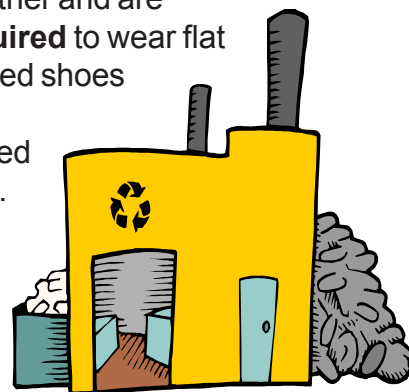
1. Tour reservations are required at least 2 weeks in advance. You can contact Ginger May or Chery Sullivan with Waste Connections at 360-737-1727 to set up and reserve a tour date. Further contact information is provided on the cover page for this unit.

2. Busing fees are covered by Clark County Solid Waste, but teachers must set up bus reservations. If you have questions about making reservations you may contact Sally Fisher with Solid Waste at 360-397-6118 ext. 4939

3. Preferably, tours are given Tuesday through Thursday between 10 am and 2 pm.

4. Group size is limited to 20 students per tour guide for safety considerations and a chaperone ratio of one adult to 5 students for grades 3-6 or one adult to 10 students for grades 7-12 is required.

5. Students should wear clothes appropriate for outdoor weather and are **required** to wear flat heeled shoes with closed toes.



DOING THE ACTIVITY

1. For the safety of your group, please keep track of your students and do not allow running, shoving or general horse play.
2. Have students fill out the **Scavenger Hunt** worksheet while on the tour to keep them engaged. They may work in pairs or individually.
3. Encourage students to ask questions. You may have them write out a few questions on the back of their **Scavenger Hunt** sheets to ask while on the tour.

FOLLOW-UP

1. After the tour have students complete the **Wasted Words** worksheet. This reinforces the general themes and new vocabulary covered during the tour. It may be helpful to have students look over this worksheet before the tour.

ANSWER SHEET

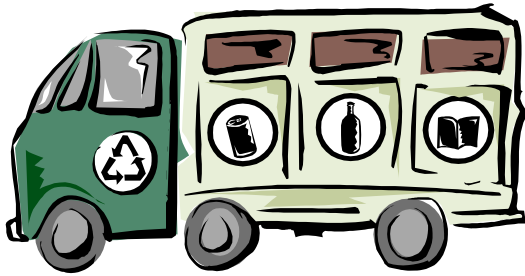
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 D R E T A L P A O B P A C P O M X E F C A R T E
 R Y B A H M E T W A D Q J F Y M Q
 R E M A N U F A C T U R E B

1. Recycling is good for the earth because it conserves **ENERGY**, reduces air and **WATER** pollution and saves natural resources from ending up in the **LANDFILL**.
2. At the **TRANSFER** Station all of our **WASTE** is packed onto a **BARGE** and sent up the Columbia River to a landfill in Oregon. Our recycling is sorted into paper, **PLASTIC**, glass and **METAL** then packed into **BALES** that will be shipped to factories that **REMANUFACTURE** them into new products.
3. Besides recycling we can also **REDUCE** the amount of resources we use, **REUSE** the resources that we already have and **BUY** recycled products to close the loop.
4. You can set out **YARD DEBRIS** (made up of leaves, twigs, and grass clippings) or mix it with other **ORGANIC** materials like vegetable scraps in a backyard **COMPOST** pile to create a rich, natural **FERTILIZER** for your garden.
5. Some things we use are dangerous if we don't dispose of them properly. Products such as used oil, strong cleaners, **BATTERIES** and **PAINT** are called **HAZARDOUS** waste.
6. Plastic bottles are made from **OIL**. This is a **NONRENEWABLE** resource so when it's gone, it's gone. When we recycle plastic we can make products like toys, **CARPET** and **FLEECE** without using new natural resources.
7. Glass is made from **SAND**. We can turn glass bottles into new **BOTTLES** or it can be mixed in **ASPHALT** and used to pave roads.
8. **CARDBOARD** and **PAPER** are a couple products made from trees. The more we conserve and recycle these products the fewer trees we will have to cut down. **MILK CARTONS** are another product made from trees that we should recycle at school.
9. **METAL** is made from earthen minerals and is used in many things such as soda cans and bicycles. Throwing cans away is a waste! An aluminum soda can takes 200-500 years to **DECOMPOSE** but if we recycle it, it can be made into new products that we can use.

WASTED WORDS

Name: _____

Directions: Fill in the blanks in the following statements using words found in the word search. 31 words are hidden and each letter is only used once. If you already know the answers fill in the blanks first and it may make the words easier to find!



R	R	E	D	U	C	E	H	O	E	N	S	L	T	B	C	S	J	K	R
E	Y	G	R	E	N	E	M	V	K	O	I	A	L	O	A	E	K	E	E
M	B	A	T	T	E	R	I	E	S	N	R	N	A	T	R	L	W	K	Z
A	H	A	Z	A	R	D	O	U	S	R	B	D	H	T	P	A	T	O	I
N	M	E	T	A	L	B	R	F	O	E	E	F	P	L	E	B	R	E	L
U	T	N	I	A	P	U	B	I	Q	N	D	I	S	E	T	G	B	C	I
F	W	A	T	E	R	Y	L	N	F	E	D	L	A	S	A	D	A	E	T
A	D	R	A	O	B	D	R	A	C	W	R	L	L	N	P	N	R	E	R
C	Q	L	P	P	A	P	E	R	A	A	A	W	I	D	O	A	G	L	E
T	J	L	T	R	C	F	X	D	G	B	Y	C	H	G	S	S	E	F	F
U	F	C	O	M	P	O	S	T	Z	L	E	S	O	P	M	O	C	E	D
R	Y	R	M	X	E	F	C	J	B	E	C	I	T	S	A	L	P	Y	Y
E	M	I	L	K	C	A	R	T	O	N	S	R	E	F	S	N	A	R	T
B	Q	N	M	W	E	S	U	E	R	W	A	S	T	E	F	V	R	D	Z

1. Recycling is good for the earth because it conserves _____, reduces air and _____ pollution and saves natural resources from ending up in the _____.
2. At the _____ Station all of our _____ is packed onto a _____ and sent up the Columbia River to a landfill in Oregon. Our recycling is sorted into paper, _____, glass and _____ then packed into _____ that will be shipped to factories that _____ them into new products.
3. Besides recycling we can also _____ the amount of resources we use, _____ the resources that we already have and _____ recycled products to close the loop.
4. You can set out _____ (made up of leaves, twigs, and grass clippings) or mix it with other _____ materials like vegetable scraps in a backyard _____ pile to create a rich, natural _____ for your garden.
5. Some things we use are dangerous if we don't dispose of them properly. Products such as used oil, strong cleaners, _____ and _____ are called _____ waste.
6. Plastic bottles are made from _____. This is a _____ resource so when it's gone, it's gone. When we recycle plastic we can make products like toys, _____ and _____ without using new natural resources.
7. Glass is made from _____. We can turn glass bottles into new _____ or it can be mixed in _____ and used to pave roads.
8. _____ and _____ are a couple products made from trees. The more we conserve and recycle these products the fewer trees we will have to cut down. _____ are another product made from trees that we should recycle at school.
9. _____ is made from earthen minerals and is used in many things such as soda cans and bicycles. Throwing cans away is a waste! An aluminum soda can takes 200-500 years to _____ but if we recycle it, it can be made into new products that we can use.

SCAVENGER HUNT

Name: _____



The **smelliest** thing: _____

3 things I saw in the **garbage** that **shouldn't** have been thrown away:

2 organic materials that were being **composted**:

The most creative way I learned to **recycle** or **reuse** something:

One thing that really **surprised** me:

My favorite kind of **bale**:

2 **statistics** I'll never forget:



cut

SCAVENGER HUNT

Name: _____



The **smelliest** thing: _____

3 things I saw in the **garbage** that **shouldn't** have been thrown away:

2 organic materials that were being **composted**:

The most creative way I learned to **recycle** or **reuse** something:

One thing that really **surprised** me:

My favorite kind of **bale**:

2 **statistics** I'll never forget:



PLEASE USE THE BACK OF ME THEN RECYCLE ME.

PLEASE USE THE BACK OF ME THEN RECYCLE ME.

WARRANTING WASTE

OVERVIEW:

Students sort school waste by material then measure the weight and volume of one day's worth of waste. Pre-prepared auditing forms contain instructions and are meant to be self teaching. Seeing first-hand the quantity and composition of the waste that they produce each day, performing a waste audit will impress upon students just how much garbage they produce everyday and how much could be diverted.

DURATION:

Audit: 45 minutes
Follow Up: 30 minutes

VOCABULARY:

audit
calibrate
compost
gross Weight
recycle
tare weight
volume

MATERIALS:

The Weight of It All
Mountains of Trash
Look at All That Trash (2)
It All Adds Up
Picture That
4 clipboards*
gloves for each student*
safety glasses*
sorting bins of known size*
tarp*
calculators
labeled bags of garbage

materials with a star (*) may be provided by guest presenters upon request

OBJECTIVE:

Students will become more aware of material resource use within their school, see what is wasted and determine how changes can be made to reduce their waste.

EALR CONNECTIONS:

Math

- 1.1 • number and numeration
- 1.1 • computation
- 1.1 • estimation
- 1.1 • attributes and dimensions
- 1.1 • approximation and precision
- 1.4 • prediction and inference
- 3.1 • analyze information
- 3.3 • draw conclusions and verify results
- 4.1 • gather information
- 4.2 • organize and interpret information
- 4.3 • represent and share information
- 5.3 • relate mathematical concepts and procedures to real-life situations

Communications

- 1.2 • listen and observe to gain information

Science

- 1.1 • properties of substances
- 1.3 • life processes and the flow of matter and energy
- 1.3 • environmental and resource issues
- 2.1 • designing and conducting investigations
- 2.2 • identifying problems
- 2.2 • evaluating potential solutions

Health

- 3.1 • understand how environmental factors affect one's health

Geography

- 3.1 • identify and examine people's interaction with and impact on the environment

Reading

- 3.2 • read to perform a task



PROCEDURE:

SETUP

1. Arrange with the custodians in advance to save a day's worth of the school's garbage and label which room/area each bag is from. This is especially **important on the "Bathroom" bags**.

2. Depending on the time you have and how many students are participating you should tailor your audit. Proportion the garbage to be audited according to the number of classes performing audits. It is difficult for one class to get through the volume of garbage that most middle schools produce in one day. If only one class is performing the audit in one 50-minute period, you may want to reduce the amount of waste you measure or sort. If several classes are participating you can divide the garbage among them, compiling data at the end. The following guidelines are appropriate for the work load of a single class.

3. Lay out tarp, set out sorting bins and hand out safety equipment. **All students and participating adults should wear protective gloves and eye goggles at all times.**

4. Calibrate the scale. All students should observe calibrating the scale and determine whether calculating tare weight is necessary. If the scale does not tare automatically, you will need to account for the weight of the container in your measurements. The tare weight is the weight of the container by itself. Tare weight will need to be subtracted from the weight of the filled container (gross weight) to measure the weight of the garbage itself.

WEIGHT OF GARBAGE = GROSS WEIGHT - TARE WEIGHT

5. Assign student tasks:

- Weight Group: 3 students + 1 recorder
- Volume Group: 3 students +1 recorder
- Sorting Group: 3 - 15 students or all others +2 recorders

*rotate the recorder's task among students

PREDICTIONS

Before beginning the audit itself, you may have students make some predictions about the resources that they will find in their waste. Some prompting questions may be:

- What material will make up the largest volume of our waste?
- What will make up the largest proportion of the weight?
- How will the waste from different rooms vary?
- Will we find more recyclable or compostable materials in the garbage than actual waste?

Notes

DOING THE ACTIVITY

Weighing, Volume Estimating and Sorting Groups will work simultaneously and cooperate with one another.

Weighing Group

1. Three students work together to weigh each bag of garbage on the scale. Weighers report their measurements to the recorder to collect data on **The Weight Of It All** Data Sheet.
2. After weighing, students pass bags to the volume estimating group.
3. When all of the bags have been weighed and the data is complete, students move to the sorting area and assist there.

Volume Estimating Group

1. Three students place pre-weighed bags of garbage in containers of known volume (garbage can or recycle bin). **Pack the material very lightly** to estimate volume. (Packing should simulate garbage bags as they are thrown into a dumpster to get a realistic estimate of volume).
2. Using the container as a gauge, estimate the number of gallons consumed by the bags. Report volume estimates to the recorder to collect data on the **Mountains of Trash** Data Sheet.
3. After estimating volume, pass garbage bags to the sorters.
4. When all of the bags have been weighed and the data is complete, students move to the sorting area and assist there.

Sorting Group

1. **Set aside all “Bathroom” bags. Weigh and estimate volume only - do not open and separate material.** Record all of this waste as “Paper - Non-recyclable.”
2. After receiving weighed and measured bags open the **non-bathroom bags** and sort garbage into containers of known weight and volume. Categories are outlined on the **Look At All That Trash** data collection sheets. This is only a guide. Add or omit categories as appropriate. You should also encourage students to make notes of unusual observations or patterns that they see. For example students may find that most of the wasted paper is thrown away in the hallway where there may not be recycling bins.
3. Once a container fills up with one type of material, have the weighing and volume estimating groups take measurements and report to the recorders to collect the data on the **Look At All That Trash** sheets. (Remember to subtract the tare weight of the bucket if the scale is not calibrated to do it for you and to pack materials lightly.)
4. Once the audit is complete, compile data on the **It All Adds Up** sheet. If other groups or classes are participating in the audit you should combine data at this time. **It All Adds Up** provides students with the opportunity to see the proportion of waste that each sorted material comprises. This may be completed as a class or in small groups.

FOLLOW-UP

Complete **Picture That** as a class, assign it as homework or for small group work.

MOUNTAINS OF TRASH

Directions:

1. Place pre-weighed bags of garbage in containers of known volume (garbage can or recycle bin). **Pack the material very lightly** to estimate volume.
2. Count the number of bags it takes to fill each container. If the bags do not fill the container completely, estimate the number of gallons the bags fill. Record volume estimates on the chart to the right.
3. After estimating volume, pass garbage bags to the sorters.
4. When all of the bags have been weighed and the data is complete, move to the sorting area to help out.

VOLUME: LET'S LOOK AT HOW HIGH OUR TRASH PILES UP EACH DAY.

BAG #	VOLUME (GALLONS)
1	
2	
3	
4	
5	
6	
TOTAL	

THE WEIGHT OF IT ALL

Directions:

1. **Make sure your scale is calibrated** before you begin measuring weight.
2. Work together to weigh each bag of garbage separately on the scale. Record your measurements on the chart to the right.
3. After weighing, pass bags to the volume estimating group.
4. When all of the bags have been weighed and the data is complete, move to the sorting area to help out.

WEIGHT: LET'S SEE HOW FAR OUR TRASH TIPS THE SCALE EACH DAY.

BAG #	WEIGHT (POUNDS)
1	
2	
3	
4	
5	
6	
TOTAL	

LOOK AT ALL THAT TRASH

VOLUME: LET'S LOOK AT WHAT'S FILLING UP ALL THOSE BAGS OF TRASH.

Directions:

1. Set aside all "Bathroom" bags - do not open and separate material. Record all of this waste as non-recyclable paper.

2. Open the non-bathroom bags and sort garbage into containers of known weight and volume according to the categories on the chart to the right. (**Pack materials very lightly in containers.**)

3. Once a container fills up with one material, estimate the volume then send it to the weight station. (Make sure materials are **not packed.**)

4. Record estimates on the chart making note of any unusual observations or patterns that you find

5. Continue this process until you've sorted through every last piece of trash!

* PACKING SHOULD SIMULATE GARBAGE BAGS AS THEY ARE THROWN INTO A DUMPSTER TO GET A REALISTIC ESTIMATE OF VOLUME.

MATERIAL		VOLUME TALLY			
PAPER	RECYCLABLE PAPER				gal.
	RECYCLABLE MILK CARTONS				gal.
	# CARTONS:				
	NOTES:				
PLASTIC	RECYCLABLE BOTTLES				gal.
	# OF BOTTLES				
	NOTES:				
METAL	RECYCLABLE ALUMINUM				gal.
	RECYCLABLE STEEL				gal.
	# OF ALUMINUM:				
	# OF STEEL:				
	NOTES:				
GLASS	RECYCLABLE BOTTLES				gal.
	# OF BOTTLES				
	NOTES:				
FOOD	EDIBLE OR COMPOSTABLE				gal.
	SWILL				gal.
	NOTES:				
OTHER:					

LOOK AT ALL THAT TRASH

WEIGHT: LET'S LOOK AT WHAT'S MAKING THOSE BAGS OF TRASH SO HEAVY.

Directions:

1. Set aside all "Bathroom" bags - do not open and separate material. Record all of this waste as non-recyclable paper.

2. Open the non-bathroom bags and sort garbage into containers of known weight and volume according to the categories on the chart to the right. (**Pack materials very lightly in containers.**)

3. After a container fills up with one material, and its volume is estimated, place it on the scale and measure its weight. (Remember to account for **tare weight** if necessary.)

4. Record weight on the chart making note of any unusual observations or patterns that you find.

5. Continue this process until you've sorted through every last piece of trash!

* WEIGHT OF GARBAGE = GROSS WEIGHT - TARE WEIGHT
TARE WEIGHT = _____

MATERIAL		WEIGHT TALLY			
PAPER	RECYCLABLE PAPER				lbs.
	RECYCLABLE MILK CARTONS				lbs.
	# CARTONS:				
	NOTES:				
PLASTIC	RECYCLABLE BOTTLES				lbs.
	# OF BOTTLES				
	NOTES:				
METAL	RECYCLABLE ALUMINUM				lbs.
	RECYCLABLE STEEL				lbs.
	# OF ALUMINUM:				
	# OF STEEL:				
	NOTES:				
GLASS	RECYCLABLE BOTTLES				lbs.
	# OF BOTTLES				
	NOTES:				
FOOD	EDIBLE OR COMPOSTABLE				lbs.
	SWILL				lbs.
	NOTES:				
OTHER:					

IT ALL ADDS UP

Directions: Add up your tally for each sorted material and record the weight and volume on the chart below. If other groups are participating in the audit you should combine your data now.



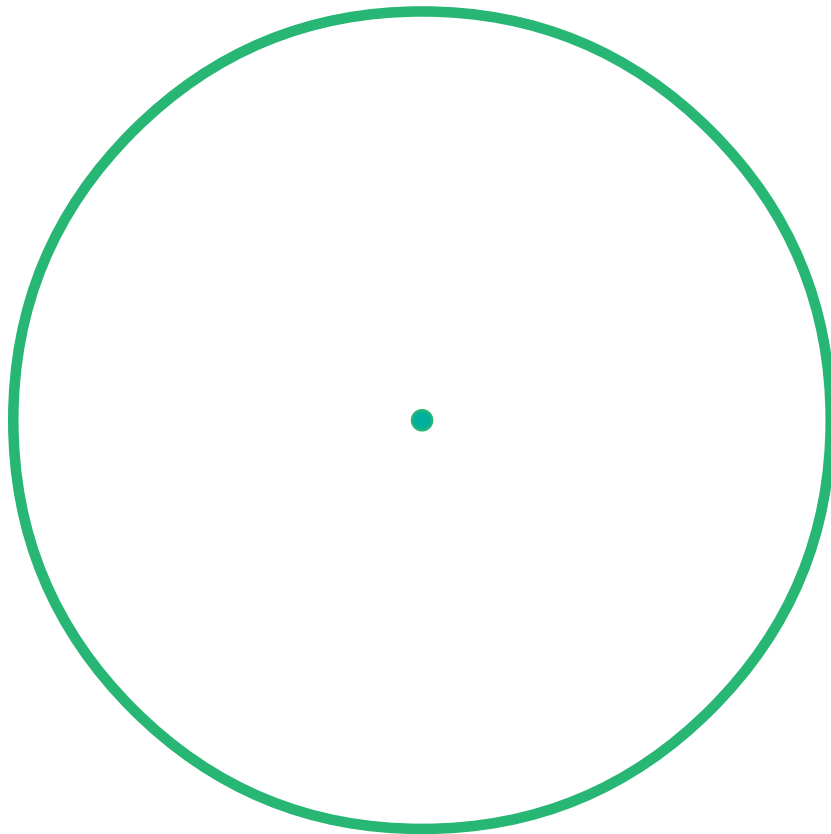
Next let's take a closer look at what we're throwing away. We already know the weight and volume of each material as well as the total weigh and volume. Now we can compare these numbers using the equations below to figure out the proportion of each material.

$$\frac{\text{WEIGHT}}{\text{TOTAL WEIGHT}} = \frac{\% \text{ WEIGHT}}{100} \quad \text{and} \quad \frac{\text{VOLUME}}{\text{TOTAL VOLUME}} = \frac{\% \text{ VOLUME}}{100}$$

MATERIAL		WEIGHT (LBS)	% WEIGHT	VOLUME (GAL)	% VOLUME
PAPER	RECYCLABLE PAPER				
	RECYCLABLE CARTONS				
	# OF CARTONS:				
PLASTIC	RECYCLABLE BOTTLES				
	# OF BOTTLES:				
METAL	RECYCLABLE ALUMINUM				
	RECYCLABLE STEEL				
	# OF ALUMINUM:				
	# OF STEEL:				
GLASS	RECYCLABLE BOTTLES				
	# OF BOTTLES:				
FOOD	COMPOSTABLE/EDIBLE				
	SWILL				
NOTES:					
OTHER:					
GRAND TOTALS		_____ pounds of garbage		_____ gallons of garbage	

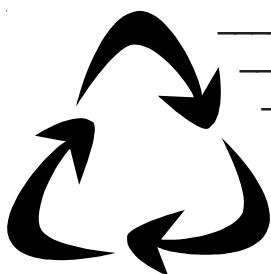
PICTURE THAT

Directions: On the circle below, make a pie chart with illustrations showing the proportions of different materials that we found in our garbage. Then use your chart to help you answer the questions below. You should include *paper, plastic, metal, glass, food* and *other* on your chart.



1. Describe at least 3 ways that we can reduce the amount of waste we produce each day.

2. Brainstorm some ways we can teach our friends about reducing, reusing and recycling...



3. How much of our waste can we eliminate if we practice waste reduction? (Hint: Look at the TOTAL% VOLUME of all the materials that can be reduced, reused or recycled (RRR) and add these up.)

% RRR PAPER	<hr/>
+ % RRR PLASTIC	<hr/>
+ % RRR METAL	<hr/>
+ % RRR GLASS	<hr/>
+ %RRR FOOD	<hr/>
+ % RRR OTHER	<hr/>
= % RRR TOTAL	<hr/>

4. Show how much waste we can eliminate on your chart.

2: WATER RESOURCES

GOAL:

Students will recognize various sources of water pollution and see the effects that this pollution has on humans, wildlife and environment. They will learn the measures we take to make both drinking and waste water safer, understand the importance of having clean water and take personal action to prevent water pollution.

DURATION:

45-60 minutes

VOCABULARY:

algae bloom
aquifer
bioswale
centrifuge
City of Vancouver
Clark Public Utilities
effluent
erosion
floc
impermeable
impervious surface
Lower Troutdale Aquifer
microorganism
non-point pollution
pervious surface
point pollution
reservoir
runoff
Sandy River Mudstone
Aquifer
sedimentation
stormdrain/catch basin
stormwater
Upper Troutdale aquifer

MATERIALS:

Water Resources
Outline Questions

OBJECTIVES:

- ◆ Become familiar with the ways we use and pollute water
- ◆ Understand how water becomes polluted and describe ways we can prevent pollution
- ◆ Determine the source and destination of our drinking water and other water sources
- ◆ Explain how safe drinking water is provided to schools in Clark County
- ◆ Describe the importance of conserving water and determine conservation methods
- ◆ Describe the wastewater treatment process

EALR CONNECTIONS:

Reading

- 1.2 • *build vocabulary through reading*
- 2.1 • *comprehend important ideas and details*
- 3.1 • *read to learn new information*

Communications

- 1.1 • *focus attention*
- 1.2 • *listen and observe to gain information*

Science

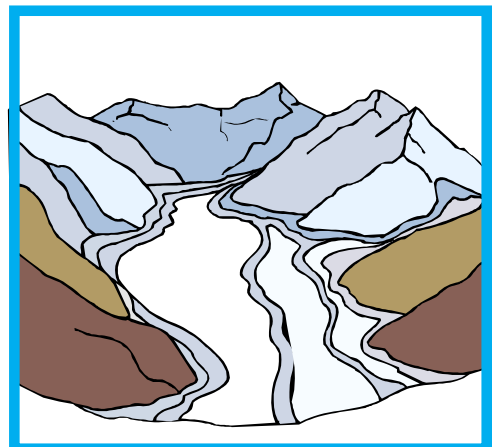
- 1.1 • *properties of substances*
- 1.2 • *systems*
- 1.3 • *life processes and the flow of matter and energy*
- 1.3 • *interdependence of life*
- 1.3 • *environmental and resource issues*
- 2.2 • *identifying problems*

Health

- 3.1 • *understand how environmental factors affect one's health*

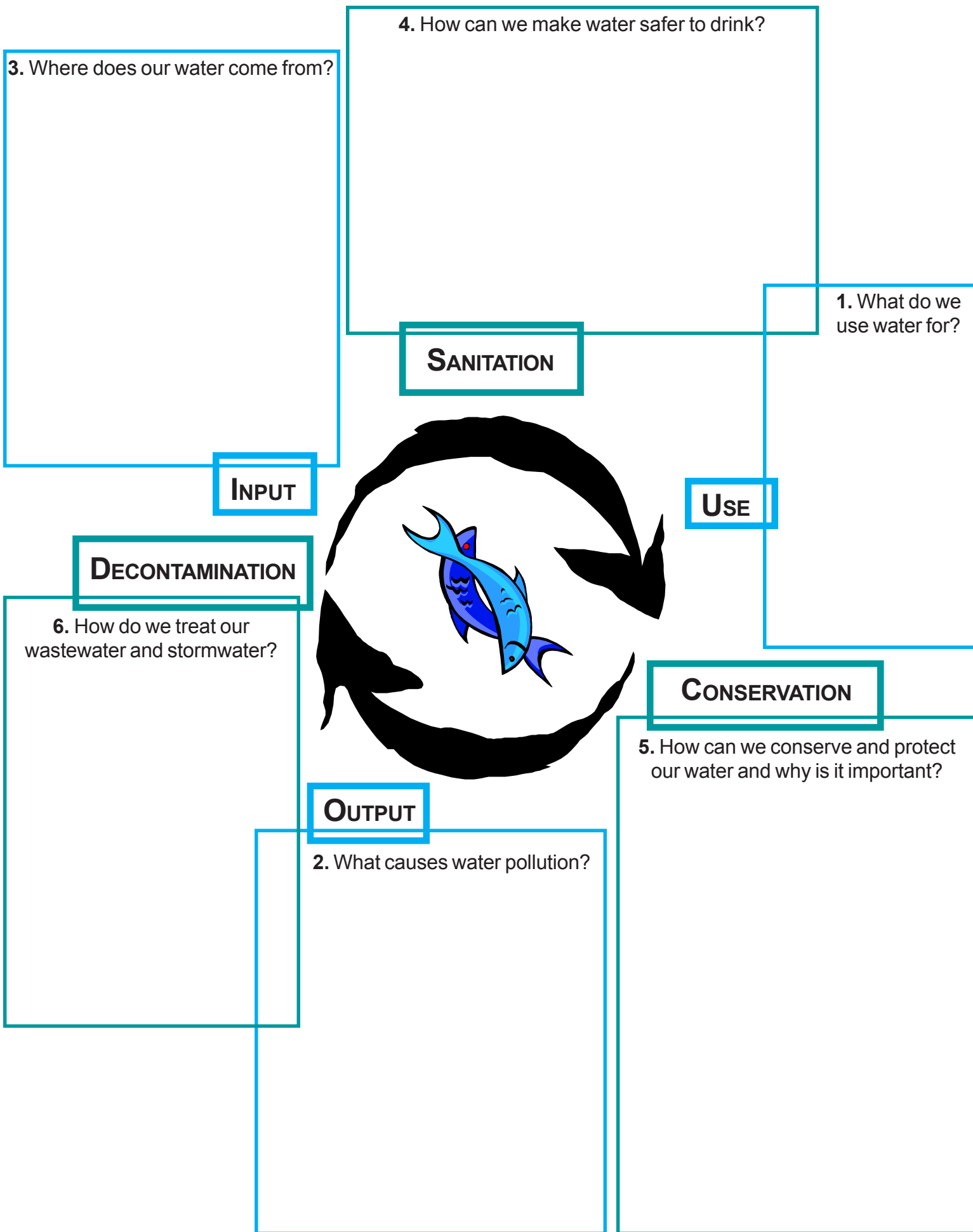
Geography

- 3.1 • *identify and examine people's interaction with and impact on the environment*
- 3.2 • *analyze how the environmental and environmental changes effect people*



Water Resources Outline Questions

Name: _____



1. What do we use water for?

The average family of four uses 350 gallons of water each day, 28 gallons of which are lost from leaks. We use this water for drinking and cooking, bathing and toileting, cleaning and washing, and caring for lawns and gardens.

Outside the home there are many other ways that water is used. Practically everything that we buy, from computers to clothes, requires large amounts of water during the manufacturing process. Producing just one computer, for example, uses 73,000 gallons of water. The food that we buy at the store also requires large amounts of water. Agricultural crops require irrigation to grow and often times additional water for processing.

2. What causes water pollution?

Many of ways we use water today can cause pollution. 150 years ago water was much less contaminated with pollutants than it is now. There were no paved roads or cars, fewer pesticides and fertilizers were applied to crops, and factories did not manufacture such toxic chemicals and products. Many of the activities we do each day lead to water pollution.

When we wash out a paint brush in the sink, we have contaminated the water with the paint and chemical cleaners. This water is contained in pipes and flows to a treatment plant designed to remove most of the organic contaminants before it is released into rivers or streams. Cleaning our waste water prevents a lot of pollution from reaching the environment. Many manufacturing processes can cause water pollution even though there are laws that set limits on the amount of pollution that factories can release into waterways with their **effluent**. When effluent is released from a manufacturing plant, it is easy to see what is causing water pollution. We call this type of pollution **point pollution** because the contamination is coming from a definite source or point.

It is obvious when point pollution occurs, so factories often take more than their share of the blame for water pollution. But in most cases, it is not clear exactly where pollution comes from. We call this type of pollution **non-point pollution**. We all contribute to non-point water pollution every day. Non-point pollution is usually associated with **stormwater**. When precipitation falls on **impervious surfaces** that water cannot penetrate, such as roofs and parking lots, the water flows down **stormdrains** as **runoff**. If there are contaminants on these surfaces, such as oil that dripped from cars, spilled chemicals or litter, they will be carried through the stormdrains. These stormdrains usually empty directly into streams and rivers.

Runoff can also occur on **pervious surfaces** such as lawns, fields or woodlands if the water is unable to soak into the earth fast enough. In this case the water may either run off into stormdrains or run directly into streams and lakes. Chemicals like fertilizer on neighborhood lawns are often washed into stormdrains when it rains. Pesticides on agricultural lands may run off directly into ditches, streams or lakes.

In addition to hazardous chemicals, some naturally occurring substances can also act as pollutants. Cow manure, dog feces and human waste all contain harmful microorganisms that are dangerous when they enter the water supply. These wastes also contain a lot of nitrogen that can cause **algae blooms** in lakes, decreasing the oxygen supply for fish. This is one reason why it is important to clean up after our pets. Even soil can act as a pollutant in some cases. **Erosion** along stream banks or at construction sites can alter wildlife habitat in streams by causing **sedimentation**. This is a common problem when there is not enough vegetation to hold the soil in place. Sedimentation can cloud water, decrease oxygen supplies and destroy rocky stream habitat. This habitat is essential to the survival of salmon and other fish who need rocky stream bottoms that are free of sediment to lay their eggs.



3. Where does our water come from?

95% of the world's freshwater is found beneath the earth's surface as **groundwater** in **aquifers**. An aquifer is made up of layers of rock that are saturated with water. When precipitation hits the earth and snow melts in the mountains, this water slowly seeps into the ground and eventually reaches a layer deep in the earth that is **impermeable**. Because water cannot move past this layer, it begins to collect and saturate the rock, forming an aquifer. After water collects in an aquifer it continues to flow very slowly underground in a more horizontal direction toward the ocean.

Clark County receives its drinking water from wells that are drilled 300-400 feet underground. These drinking water wells tap into three aquifers; the **Upper Troutdale**, **Lower Troutdale** and **Sandy River Mudstone aquifer**. Some neighboring counties get their drinking water from above ground **reservoirs** in the mountains that collect and store snowmelt behind dams. Both aquifers and reservoirs are replenished with rain and snowmelt from the mountains.

The **City of Vancouver** and **Clark Public Utilities** are responsible for providing drinking water to most residents of Clark County. Some residents have private wells. The City of Vancouver pumps approximately 9.5 billion gallons of water each year from 44 wells. Clark Public Utilities draws water from 33 wells that pump 24.5 millions gallons of water per day, providing most of the water supply for the rest of Clark County. Water is distributed to customers through more than 700 miles of water pipes in the City of Vancouver alone.

4. How can we make water safer to drink?

Before water comes to your home or school for use it goes to a water treatment plant to make it cleaner and safer to drink. Through our daily actions we all contribute to water pollution and this pollution can contaminate our drinking water. When water flows underground, harmful

substances that may have filtered through the ground can collect in aquifers. Improper industry disposal, sewer systems, leaky underground gas and oil tanks, landfills and nuclear sites are some things that can cause groundwater contamination if they are not properly maintained. Naturally occurring substances such as iron and manganese may be present in the water as well. Water may also contain **microorganisms** that can cause sickness.

These human-made and natural substances need to be removed and microorganisms must be killed before water is safe to drink. At the drinking water treatment plant water goes through several stages to remove organic contaminants, making water safer to use.

DRINKING WATER TREATMENT

Coagulation: Chemicals are added to the water to form tiny particles called **floc** which attract dirt particles suspended in the water.

Sedimentation: When the floc particles become heavy with dirt they settle out and sink to the bottom of holding tanks leaving the cleaner water at the top.

Filtration: The cleaner water moves through a filter made of layers of sand, gravel and charcoal. Greensand filters are used to remove naturally occurring metals like iron.

Disinfection: The microorganisms in the water are killed using chlorine which is similar to weak household bleach. Water is then passed under an ultraviolet light to kill anything the chlorine may have missed.

Testing: All water utilities are required to take water samples from throughout the treatment system to detect if contamination is a problem. Results of the tests are reported to the state health department. The City of Vancouver is required to take a minimum of 200 bacteria samples per month.

5. How can we conserve and protect our water and why is it important?

Although 70% of the earth's surface is covered with water, only 3% of the water on earth is fresh water. Freshwater can be found in lakes, rivers and streams, as groundwater in aquifers and frozen in polar icecaps. Most of this freshwater is frozen in ice caps, leaving less than 1% of all water available for use. Because all living things need water, conserving water and protecting it from contamination is important.

Water Conservation

Because water is a renewable resource and it moves through a natural cycle, it is difficult to imagine running out, but it's important to remember that water, like all other renewable resources, requires time to replenish itself. Ground water must filter into the earth and collect in aquifers before we can pump it out with a well. In many parts of the world, drinking water is very sparse and people must travel far on foot to access it. 40% of the world's population is faced with shortages of safe drinking water. Some parts of the United States are depleting aquifers and reservoirs faster than they can be naturally replenished.

In Clark County we depend heavily on rain and snowmelt to replenish our aquifers. Snowpack in the Cascades has been decreasing over the years, but our population is continuing to grow. As a result, our community is demanding more and more fresh water from sources that are slowly shrinking. Residents of Clark County alone use enough water to fill about 270 swimming pools each day. It is important to conserve water so that in the future we are not faced with shortages of this precious resource. Water conservation is especially important in times of drought and low snowpack when there is less water to replenish aquifers, irrigate crops and fill rivers and streams for wildlife habitat.

Another reason why water conservation is important is because using water costs money. When we run the kitchen sink faucet, take a shower or flush the toilet we are paying for the water that comes in through the pipes and we are also paying to send that water down the drain. We have to pay for water because it takes a lot of hard work and energy to make our water safe for use and to clean it up after we use it. When drinking water flows through pipes to a school or home it passes through a water meter that measures the amount used in cubic feet. Clark Public Utilities and the City of Vancouver monitor how much water is used and charges their customers according to the amount of water they use. We also pay these utility companies to clean our waste water for us. So when we conserve water, we save both the cost of the water and the cost of disposal!



There are many things we can do to reduce the amount of water we use. Becoming more aware of the ways we use and waste water is the first step in conservation. Taking shorter showers, flushing the toilet less often and avoiding leaving the faucet on when we are not using water are some simple things we can all do. We can also fix leaks and buy water saving devices such as low flow shower heads and soaker hoses. Naturescaping in our yards and using native plants can greatly reduce the amount of water we need to keep our landscaping alive during the dry summer months.

Water Protection

Preventing water pollution is just as important as water conservation. Because we all do things that contribute to water pollution, we all need to make an effort to protect water from contamination. The majority of water pollution occurs when rainwater runoff carries all of our pollutants such as oil, chemical fertilizers and soil into stormdrains or directly into streams. There are many things we can do to reduce our impact on water quality.

Naturescaping in our yards not only conserves water, but also helps prevent water pollution. Because **native plants** are well adapted to the pests and climate of the Pacific Northwest, they are more resilient and need less watering, pesticides and fertilizer. Restoring watersheds with native trees and plants along stream banks helps prevent erosion and keeps water cooler. Clear and cold water is essential for the survival of many water insects and fish like salmon.

In some situations, like farming and gardening with **nonnative plants**, we may need to add **soil amendments**. If our yard is already landscaped with nonnative plants such as grass, limiting our use of chemical pesticides and fertilizers is an important way to reduce water pollution. In our yards we can use safer alterna-



tives to chemical fertilizers such as compost and follow directions carefully if we do choose to use chemicals. We can also support farmers who use alternatives to chemical fertilizers and pesticides by buying organic produce.

Another important way to reduce water pollution is by driving less and maintaining our cars if we do choose to drive. Cars contain many fluids that are toxic to the environment like gasoline, oil, antifreeze and brake fluid that can drip out onto roads and parking lots, leading to water contamination. Limiting our use of these toxic fluids and other hazardous waste products like household cleaners, batteries and paints helps to protect water from pollution.

6. How do we treat our wastewater and stormwater?

Wastewater Treatment

Many of the ways we use drinking water would cause incredible water pollution if we did not clean our water after we use it. The environment would become contaminated very fast if we released all of the things that we put down our drains and toilets directly into rivers. In addition to harming wildlife, these waste products, such as solvents, cleaners, human waste and paint would eventually find their way back to our drinking water supply. To reduce water pollution we send our wastewater to treatment plants where some of these materials are removed before the water reaches the Columbia River.

Seven wastewater treatment plants near the Columbia River operate 24 hours a day, seven days a week, 365 days per year in Clark County. Each day they clean a combined total of 26 million gallons of wastewater. That is enough wastewater to fill 140 swimming pools every day! Vancouver's waste water treatment system has about 650 miles of waste water pipes and about 20 new miles of wastewater pipes are added to the sewer system each year to accommodate for our growing population. When the water reaches the treatment plants it passes through several treatment processes.

WASTEWATER TREATMENT

Filtration: First, the wastewater passes through a screen to remove large pieces of paper and other debris.

Primary Treatment: After large debris is removed, the wastewater is held in large **settling tanks** to allow the heavier waste to separate from the cleaner water and settle to the bottom using the force of gravity.

Secondary Treatment: After the heavier substances settle out of the wastewater, the cleaner water moves to another set of tanks where helpful bacteria are added to consume organic contaminants.

Sterilization: After bacteria have eaten the organic contaminants the cleaner water passes under ultraviolet lights to kill any additional harmful microbes before entering the Columbia River. Once the water joins the river, the water cycle takes over and continues to purify the water through evaporation, condensation and precipitation.

Water Removal: The contaminants from the primary and secondary treatment process are mixed together and put in a gravity thickener tank. The heavier sludge from the tank goes to a gravity belt thickener and more water drains through holes in the belt. A chemical is injected to thicken the sludge. The thickened sludge is then put into a **centrifuge** so most of the water is spun out. Finally, the dried sludge is burned in an incinerator, and the ash is taken to a sanitary landfill.

Stormwater Treatment

Contaminated stormwater can be a hazard to natural habitat, people and wildlife. In natural habitats, rain water seeps into the ground and the microorganisms living in the earth work to break down any contaminants before the water reaches streams or aquifers. Much of the surface in urban communities like Clark County are covered with impervious surfaces, preventing this natural filtration process. In urban environments, elaborate systems of drains and pipes are constructed to deal with stormwater to prevent flooding. Since it rains about 45 inches each year in Clark County, it's not hard to find a stormdrain or ditch.

Stormdrains direct water off of parking lots, roads and roofs into the ground or directly into local streams and ponds. Contaminates such as fertilizer, soil and litter are washed with the storm water into these aquatic habitats.

Stormdrains and Catch Basins

Stormdrains are designed in a special way that can help reduce the amount of contaminants that wash into streams. Stormdrains or catch basins have a grate on the top of the drain that keeps large objects like soda bottles and tennis balls from entering the drain system. The drain is designed so that heavy contaminants like soil sink to the bottom of the drain, while other substances, such as oil, float on the surface of the water. This creates layers of dirty and cleaner water. The pipe is designed to come into the drain at the layer of cleaner water. The cleaner water then flows out of the drain through the pipe and is released into local streams. This design only works if stormdrains are maintained and cleaned out periodically.

Bioswales

To prevent and contain the contamination of storm water, many communities including Clark County use **biofilter swales** or **bioswales** to catch some pollutants before they reach local streams. Bioswales are shallow depressions built in the ground, typically near parking lots, that resemble small ponds. These swales are covered with vegetation like grasses and trees and act a living filter for stormwater. The vegetating in the biofilter swales catch the contaminants in stormwater and allow these pollutants to settle to the bottom of the swale. Much like in nature, microorganisms living in the earth help to break down contaminants as water filters through the ground. The cleaner water on top then flows through stormdrains and is released into streams. In recent years, construction of many new developments in Clark County have included small depressions and ponds that serve as living filters and provide a good habitat for some birds and animals.

WATER POLLUTION SOLUTION

OVERVIEW:

Students play the role of water molecules moving through a water cycle filled with pollutants. This interactive game teaches students the various ways our water resources become polluted and shows them how this pollution effects the environment.

SKILLS:

independent work
critical thinking
writing
reading
following directions
class participation

DURATION:

Game: 25 minutes
Follow Up: 20 minutes

VOCABULARY:

condensation
evaporation
non-point pollution
point pollution
precipitation
runoff
transpiration

MATERIALS:

9 jars
9 envelopes
9 small brown bags
15 dry beans per student
Cycle Slips
Station Cards
One baggy/student
Pollution Solution

OBJECTIVE:

Students will understand the various ways that water can become polluted as it moves through the water cycle, explain how water pollution adversely effects the environment and describe ways that we can keep our water clean.

EALR CONNECTIONS:

Reading

3.2 • *read to perform a task*

Writing

2.3 • *write in a variety of forms*

3.1 • *prewrite*

Science

1.1 • *nature and properties of earth materials*

1.2 • *physical/chemical changes*

1.3 • *life processes and the flow of matter and energy*

1.3 • *interdependence of life*

1.3 • *environmental and resource issues*

Geography

3.1 • *identify and examine people's interaction with and impact on the environment*

Arts

1.3 • *use and develop arts skills and techniques to solve problems and express ideas*

3.1 • *use image, sound, and movement through the arts to express individual ideas for a specific purpose*

4.1 • *use art skills and knowledge in other subject areas*

PROCEDURE:

SETUP

1. Cut out station cards and place them around the room. Next cut out water cycle slips and place them in envelopes according to their station groupings (groupings are denoted with a number). Place these envelopes around the room at their appropriate stations.

2. Fill bags with pollution tokens (beans) and set them to the left of each station card. Place one empty jar for collecting the pollution tokens to the right of each station card. Arrows on station cards should make it clear to students which container is for withdrawing tokens and which is for deposits.



INTRODUCTION

1. You may want to briefly cover or review the water cycle with students before beginning the activity. They probably have already learned the basic water cycle revolving around **evaporation**, **condensation** and **precipitation**.
2. Explain to student that they are going to play the role of water molecules in a game to gain a better understanding of a water drop's life cycle because in reality there is much more to the cycle than three steps.

DOING THE ACTIVITY

1. While students are still seated explain the rules of the game:
 - a. Each student will play the role of a water molecule and cycle through 9 stations: cloud, ocean, plant, animal, lake, stream, wilderness, groundwater and settlement. Point out these stations to the students. These stations represent some of the places that water moves during the water cycle.
 - b. Students will start at different stations. Students may need to wait their turn in line at some stations. At this time pass out a **Pollution Solution** worksheet to each student and divide students evenly into nine groups. Have students remain seated. An easy way to group students is by writing in the first station on their worksheets prior to handing them out.
 - c. At each station there is an envelope full of cycle slips. When students move to a station they will take one slip without looking and read it to themselves. After reading the slip make sure it gets back into the envelope that it was taken from.

d. The slip will tell students where to move next in their cycle. It will also tell them if and how they have been polluted at their station. If they have been polluted they should take 5 pollution tokens from the brown bag and put them in their baggy.

e. After drawing a slip students should briefly record what happened to them at the station (key words are underlined for notes). Students should also record if they were polluted or not (pollution slips are outlined in red) and write in their next destination in the water cycle. After recording students can move to their next station.

f. Whenever a student moves to the new station, if they have any tokens they should first deposit one of their tokens into the cup before drawing a new slip. If a slip is drawn a second time, return it to the envelope and draw a new slip.

g. Continue in this fashion, following the directions on the slips until the game ends. Students should continue cycling for a set time period or until their **Pollution Solution** sheets are complete. Ten or fifteen minutes is usually sufficient.

FOLLOW-UP:

DISCUSSION

After the game have students return to their seats and go over some questions informally as a class.

1. **Where does water pollution come from?** Discuss what kinds of pollution students encountered on their journey as water molecules. Have students count their tokens. Who was the most polluted at the end of the game? Have them share how they got so polluted. Did anybody make it through the game without getting polluted? Which stations did they visit? What are some other sources of pollution that students picked up?

2. What's the difference between point and non-point pollution?

Make sure students understand the difference between **point** and **non point pollution**. There are two examples of point pollution that were in our water cycle (paper mill and oil tanker). Can anybody name these point pollution sources?

It is important students understand that *non point pollution* is the major cause of water pollution. Does this surprise anybody? Many people think that factories or oil spills are to blame for water pollution because it is very dramatic when such pollution does occur.

3. Who contributes to water pollution?

In reality we all contribute to water pollution. It is the little things we do each day like improperly fertilizing our lawns or driving a car that leaks oil that accounts for the majority of water pollution. Can students name some of the things we do right here in our community that leads to pollution in our water?

4. How is water pollution harmful?

Explain to students that because we all contribute to water pollution, we all need take responsibility to help prevent it. When we pollute, it harms our environment that we and wildlife are dependent on. How do the different pollutants that we encountered on our journeys harm the environment, wildlife and ourselves?

5. How can we prevent water pollution?

Now we see why it is important to prevent water pollution. Do students have any ideas how we can prevent water pollution in our community, at home or at school?

ASSIGNMENT

Have students write a short comic strip using the grid on their **Pollution Solution** worksheet describing their journey as a water molecule. They should use their worksheet as a guide and include what happened to them at each station and if and how they got polluted.

More importantly have students describe how we and our environment are effected by this pollution and what we can do to prevent it. You may have students include what type of transformations they experienced between stations (evaporation, condensation and precipitation) and/or if they got polluted by a point or non point pollution source.

WATER POLLUTION SOLUTION

Directions: Fill out the chart below as you move through the water cycle stations. Be sure to record which stations you visit and what happens to you at each station. After the activity use the grid at the bottom to make a comic strip to illustrate your day in the life of a water molecule.

Name: _____

DID YOU KNOW THAT LESS THAN 1% OF THE EARTH'S WATER IS DRINKABLE?

STATION	WHAT HAPPENED TO ME?	POLLUTION?
		YES/NO
		YES/NO
		YES/NO
		YES/NO
		YES/NO
		YES/NO
		YES/NO
		YES/NO
		YES/NO
		YES/NO



WE ALL LIVE IN A WATERSHED

OVERVIEW:

Students will read a topographic map, learn about a fictional community and interpret water quality information to determine the various sources that can contribute to non-point water pollution.

DURATION:

45-55 minutes

VOCABULARY:

algae bloom
non-point pollution
point pollution
watershed

MATERIALS:

Windy Lake Map
Community Background
Water Quality Test Results
We All Live In A Watershed

OBJECTIVE:

Students will learn how to read a topographic map, analyze water quality data, understand how water moves within a watershed and recognize some of the various sources of non-point water pollution.

EALR CONNECTIONS:

Reading

- 2.1 • comprehend important ideas and details
- 2.2 • expand comprehension by analyzing, interpreting, and synthesizing information and ideas
- 3.1 • read to learn new information
- 3.2 • read to perform a task

Communications

- 1.2 • listen and observe to gain and interpret information
- 3.2 • work effectively as a member of a group

Science

- 1.2 • systems
- 1.3 • life processes and the flow of matter and energy
- 1.3 • interdependence of life
- 2.1 • develop abilities necessary to do scientific inquiry

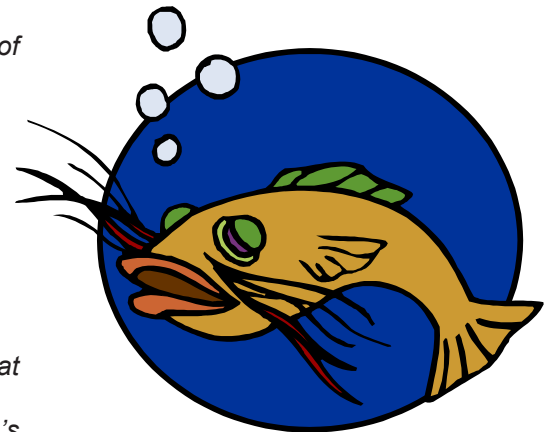
Geography

- 1.1 • use and construct maps, charts, and other resources
- 1.2 • recognize spatial patterns on Earth's surface and understand the processes that create these patterns
- 3.1 • identify and examine people's interaction with and impact on the environment

PROCEDURE:

SETUP

1. Divide students into groups of 3 and give each group a copy of *Windy Lake Map*, the *Community Background* and *Water Quality Test Results* handout and one *We All Live In A Watershed* worksheet.



DOING THE ACTIVITY

1. The *We All Live In A Watershed* worksheet is a self teaching exercise. Instructions are provided on the worksheet, guiding students through each of the questions.

Students may need help getting started with reading their maps if they are unfamiliar with topographic maps. Provide assistance as needed, encouraging students to work through problems that they encounter.

2. The worksheet contains a break where students are instructed to pause and listen to a story after answering questions 1 through 4. Naturally, some students will reach this point before others. All students should have reached this breaking point fifteen minutes into the activity. If some students are struggling, you may have other groups assist.

When all groups have completed their worksheets through question 4 read the following article aloud or select students to read.

3. After the article is read have students return to their worksheets and attempt to solve the mystery of the fish deaths. The remainder of the questions should take about 20 minutes.

FOLLOW-UP

1. After students have completed their worksheets facilitate a group discussion about the activity. Find out how each group solved the mystery. Focus some attention on questions 9 and 10. What were some ideas about what was contributing to the pollution? Which group had the most original ideas on how to prevent pollution? Ask students if they know where any of these factors may be contributing to water pollution in their own community.

Tragedy Strikes Windy Lake

Windy Lake was a rather quiet community until recently when a feud broke out in town. Early in May this year, dead fish began washing up on the shores and causing an awful stench in town. No one knew what was causing the deaths but some Windy Lake residents had suspicions.

Newer residents who are moving into the Deer Acres neighborhood began to blame the Pulpson Paper Mill for polluting the lake. They claim that the Mill is releasing chemical pollutants that are washing downhill into the lake and killing fish. They are urging the city to force the mill to relocate south of town where it will be further from Windy Lake.

Many of the residents who have lived in the Pheasant Run neighborhood for decades are employed by Pulpson Paper Mill. Employees believe that the mill is running clean because they have never had a problem with water quality in the lake until recent years, when newer residents started flocking in.

Moving the mill will cost a lot of money and Pulpson will have to lay off many employees to make up for the moving expenses. Long time residents want the city to conduct some water quality tests to determine what caused the fish deaths before the mill is forced to relocate south of town.

WE ALL LIVE IN A WATERSHED

Directions: Use the Windy Lake Map and other resources provided and to answer the questions below.

Names: _____

* **BEFORE YOU BEGIN**, look over the map to become familiar with the community, then read through the description of the community background.

1. On a topographic (topo) map contour lines mark changes in elevation, creating a picture of the landscape that shows where hills, mountains and valleys are located. Look at the contour lines on your map. Each contour line is numbered and represents 10 feet in elevation change. Label the highest point on your map with a H and the lowest point with an L. What kind of geological feature did you label with an H? _____

2. Locate all of the hills on the map and place a P at the peak of each hill.

3. Locate the streams on the map. Draw an arrow beside each stream to show which way the stream is flowing. Remember water always flows downhill. Place a star at the headwaters (beginning) of each stream and an X on the stream where water drains out of the lake.

How many streams drain into Windy Lake? _____

How many streams drain out of the lake? _____

Are there any streams on the map that are not connected directly with Windy Lake? _____

4. Connect the peaks of each hill (marked with Ps) with a dotted line, dragging your pencil along the highest elevations between peaks. You should end up with an arc-like shape around the lake that outlines the watershed.

What is a watershed? (Hint: which way are the streams flowing in relation to this outline?)

* **STOP HERE** to listen to the story of Windy Lake before you continue.

5. Locate Pulpsons Paper Mill on your map. Do you think that the Mill is responsible for the water pollution and fish deaths in Windy Lake? Why or why not? Circle the evidence on your map to support your answer. _____

6. Locate the proposed site to relocate the Paper Mill. If the Mill is releasing pollutants, would building a new Mill at this site be a good decision? Why or why not? _____

* **STOP HERE** and look over the water quality test results.

7. Does the data from the test results show that Pulpson Paper Mill is or is not responsible for the fish deaths in Windy Lake? How do you know? Does this data support your answer to question 5?

8. Can you conclude that Pulpson's is not releasing any chemical pollutants? Where should additional testing be done to determine if Pulpson is releasing pollutants?

9. *If* Pulpson's Mill is not responsible for the fish deaths, then who is? According to the test results, how might the following sources be contributing to the water pollution in Windy Lake?

Windy Lake Mall: _____

Pheasant Run Neighborhood: _____

Lakeside Park: _____

*Bingo Ranch: _____

Deer Acres Neighborhood: _____

Clover Leaf Farms: _____

Windy Golf Club: _____

10. What could be done at the following sites to prevent water pollution?

Windy Lake Mall: _____

Pheasant Run Neighborhood: _____

Lakeside Park: _____

*Bingo Ranch: _____

Deer Acres Neighborhood: _____

Clover Leaf Farms: _____

Windy Golf Club: _____

LEDGEND



green spaces



water



buildings

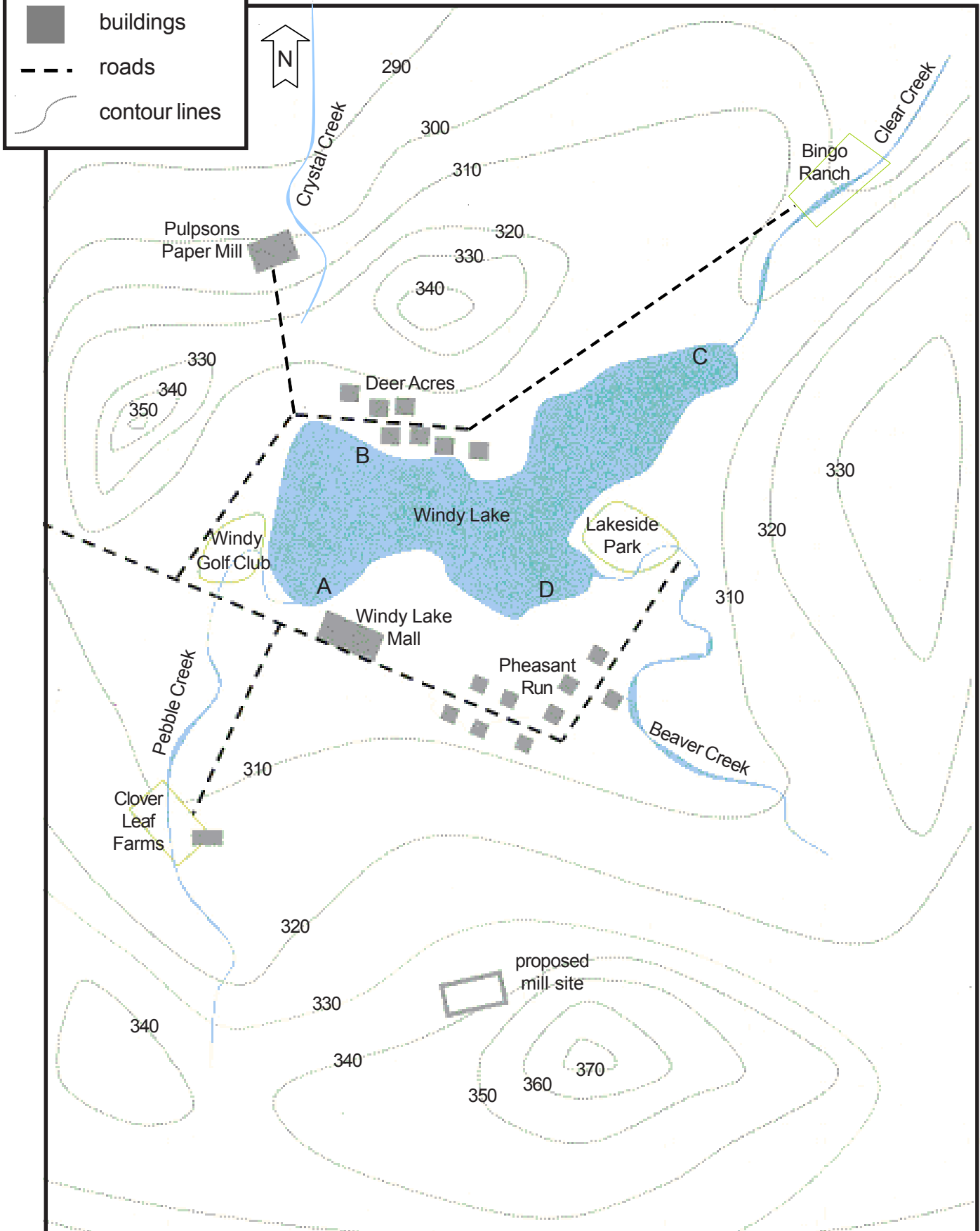


roads



contour lines

WINDY LAKE MAP



COMMUNITY BACKGROUND

Clover Leaf Farm is a small family owned farm that grows soybeans and corn. The farm is irrigated using water from Pebble Creek, which flows through the farm.

The **Pheasant Run** neighborhood is historic with some houses dating back to the early 1900s. Residents living here are very proud homeowners. The houses are well kept but some have outdated plumbing and septic systems that are in need of replacing.

Pulpsons Paper Mill has been around for nearly 80 years, turning local white pine forests into paper products. Almost half of the Windy Lake community earns a living at this mill and employees take pride in their work.

Windy Golf Club is a beautiful, well maintained 18 hole course that follows Pebble Creek along the shore of Windy Lake. It has doubled in size over the last five years to keep up with the growing demand in the community.

Lakeside Park is popular for picnicking and wildlife watching. Pet owners use the park for exercising their dogs in the off-leash area near Beaver Creek. A beautiful, pet friendly jogging trail also follows the creek.

Bingo Ranch is a large stock yard where cattle are raised. The cattle graze on 55 acres of grasslands and have access to Clear Creek for watering.

The **Deer Acres** neighborhood is very new. Development began about 5 years ago. The neighborhood continues to grow rapidly as land is cleared and new houses are built along the hilly shore of Windy Lake.

Windy Lake Mall is a popular strip mall, providing the community with a supermarket, a gas station, two restaurants and several local stores. Since the community has grown the city has built a large parking lot in the back to accommodate the increasing number of cars.

WATER QUALITY TEST RESULTS

<p style="text-align: center;"><u>Site A</u></p> <p>Chemicals: oil products Nutrient load: very high Clarity: low Temperature: 57 degrees Dissolved oxygen: very low</p>	<p style="text-align: center;"><u>Site C</u></p> <p>Chemicals: none found Nutrient load: normal Clarity: normal Temperature: 55 degrees (normal) Dissolved oxygen: normal</p>
<p style="text-align: center;"><u>Site B</u></p> <p>Chemicals: none found Nutrient load: normal Clarity: very low Temperature: 58 degrees Dissolved oxygen: low</p>	<p style="text-align: center;"><u>Site D</u></p> <p>Chemicals: none found Nutrient load: very high Clarity: low Temperature: 57 degrees Dissolved oxygen: very low</p>
<p>Conclusion: High levels of nutrients in parts of Windy Lake caused an algae bloom. The fast growth of this algae took dissolved oxygen, which fish need to live, out the water. In addition to the algae bloom, sedimentation (soil) in parts of the lake is making the water cloudy and increasing the temperature of the water. This temperature increase reduces the oxygen supply even more. Due to lack of oxygen, many fish in Windy Lake have died.</p>	

3: ENERGY RESOURCES

GOAL:

Students will be able to describe some of the environmental, social and economic impacts associated with various types of energy production and use, understand the relationships between these impacts and energy conservation, and use this new information as a source of motivation for making positive changes in personal energy use.

DURATION:

45-60 minutes

VOCABULARY:

Clark Public Utilities
chain reaction
combined-cycle combustion turbine
energy
energy conservation
energy efficiency
global climate change
greenhouse effect
greenhouse gases
infrastructure
Kilowatt Hour (kWh)
kinetic energy
law of conservation of energy
Northwest Natural
nuclear fission
photovoltaic cells
potential energy
radioactive
River Road Generating Plant
semiconductor
therm
watt

MATERIALS:

Energy Resources
Outline Questions

OBJECTIVES:

- ✦ Become familiar with the ways we use and waste energy
- ✦ Understand and apply some of the basic laws of energy
- ✦ Describe how various natural resources can be used to generate energy and which resources are used locally
- ✦ Identify some the economic, environmental and social impacts of energy production
- ✦ Understand why it is important to conserve energy and identify conservation methods.
- ✦ Describe where various energy resources come from and identify them according to natural resource type.

EALR CONNECTIONS:

Reading

- 1.2 • *build vocabulary through reading*
- 2.1 • *comprehend important ideas and details*
- 3.1 • *read to learn new information*

Communications

- 1.1 • *focus attention*
- 1.2 • *listen and observe to gain information*

Science

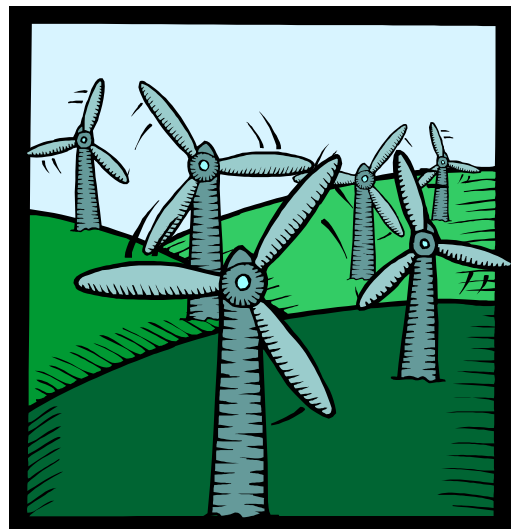
- 1.1 • *properties of substances*
- 1.2 • *systems*
- 1.2 • *energy sources and kinds*
- 1.2 • *energy transfer and transformation*
- 1.3 • *life processes and the flow of matter and energy*
- 1.3 • *interdependence of life*
- 1.3 • *environmental and resource issues*

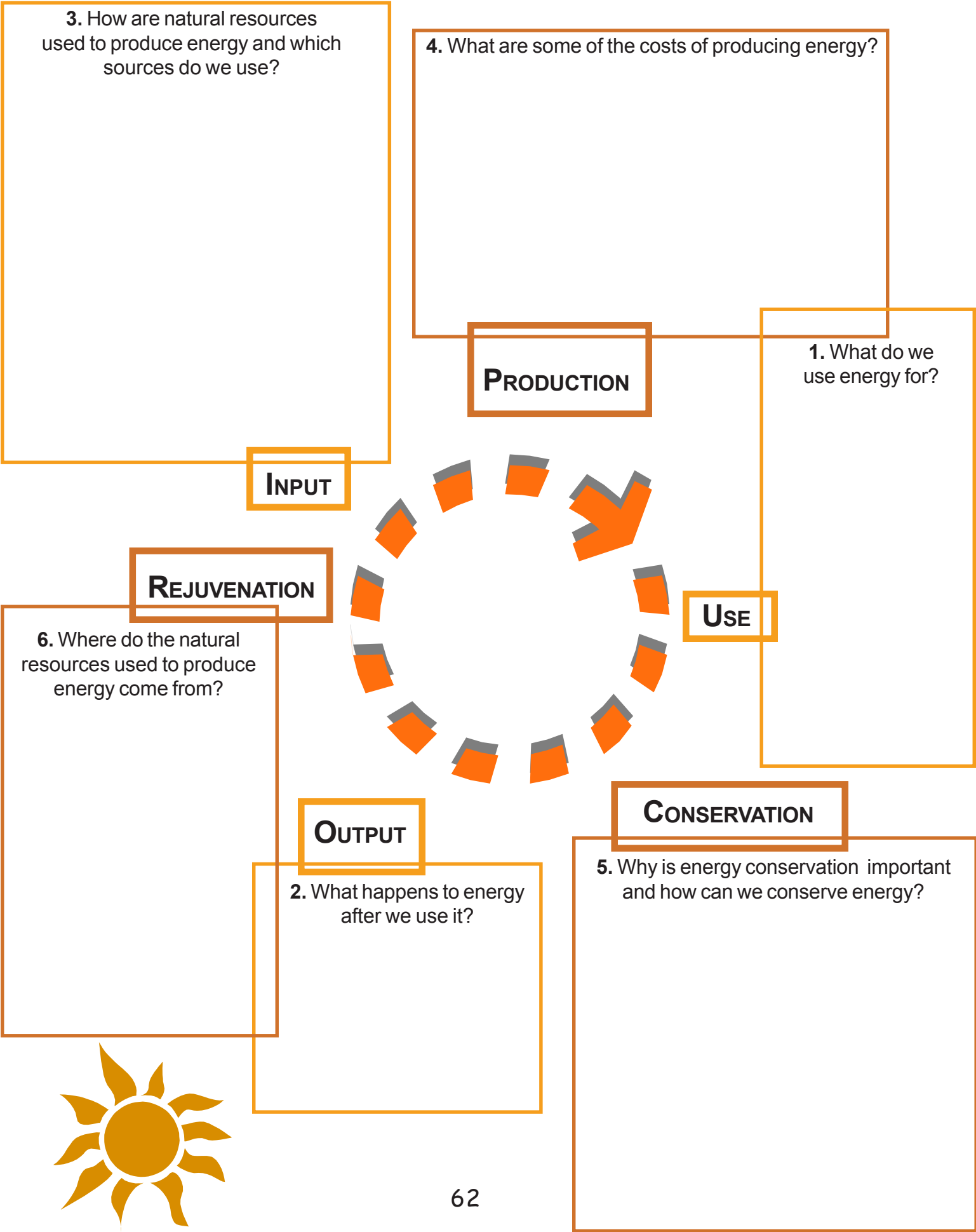
Health

- 3.1 • *understand how environmental factors affect one's health*

Geography

- 3.1 • *identify and examine people's interaction with and impact on the environment*
- 3.2 • *analyze how the environmental and environmental changes effect people*





1. What do we use energy for?

Energy is the ability to do work. There are two basic types of energy, **potential** and **kinetic**. Potential energy is energy that is stored and kinetic energy is active energy. The food that we consume is an example of potential energy. Our bodies convert food energy into kinetic energy when we exercise and think.

There are many sources of energy other than food that help us do work every day. We use gasoline in our cars for transportation, electricity in our homes to create light and to power appliances and natural gas to heat our school. We also use a lot of energy to grow the food that we eat and manufacture the products that we buy such as clothes and bikes .

We rely on energy for many things every day. As Americans we use more energy than any other country . Americans consume 25% of the world's energy even though less than 5% of the world's population lives in the United States.

2. What happens to energy after we use it?

The **law of conservation of energy** states that the amount of energy in the universe is always constant. This energy cannot be created or destroyed, it can only be transformed from one state to another.

When we use electricity to power a light we are transforming this electrical energy into light energy which dissipates to illuminate the room. Burning natural gas to heat our homes converts potential energy in the fuel into heat energy which also dissipates. When energy is converted from one state to another, some energy is "lost" in the process. For example, some of the energy used to light a light bulb is not turned into light energy that we can use, but is lost as heat. The more energy that can be used the way we intend to use it, the more **energy efficient** the process is. No processes can occur with 100% efficiency.

3. How are natural resources used to produce energy and which sources do we use?

The main source of energy used to heat schools and homes in Clark County is natural gas. Natural gas is also used to produce 45% of our electricity. The other 55% of our electricity comes from hydropower.

Fossil Fuels

Fossil fuels such as natural gas can be used to produce heat for homes and schools. Natural gas is transported through small pipes that flow into the school or house's furnace. The natural gas is mixed with air and ignited into a very hot and clean burning flame that heats air or water to make steam. The heated air or steam, then flows through ducts or pipes to heat the air in the building. Large fans powered by electricity move the heated air from one part of the building to another.

Fossil fuels like coal and natural gas can also be used to produce electricity in a generating plant. The **River Road Generating Plant**, located along the Columbia River, produces electricity by burning natural gas. At the plant natural gas is used in a **combined-cycle combustion turbine**. A combustion turbine is a lot like a jet engine. Natural gas is burned in a gas turbine to turn a generator. The hot exhaust given off by the gas turbine is used to heat water, which produces steam. The steam is then used to turn a steam turbine that is also attached to the generator.

Hydropower

Hydropower dams built along the Columbia River System produce just over half of the energy used in Clark County. The Columbia River has a total of 11 dams, 4 of which generate power after the Snake River flows into it. The Columbia River's headwaters begins in Canada at an elevation of over 3,500 feet and flow into the Pacific Ocean.



Dams are large concrete structures built across rivers that prevent the water from flowing naturally through the river system. When a large dam is built, a reservoir that stores water forms behind the dam. The water behind the reservoir is at a higher level than the river below the dam so the water contained in the reservoir has a lot of potential energy. Some large dams, like the Bonneville Dam, have turbines that can be used to generate electricity using the kinetic energy of moving water. When the water rushes through the turbines in the dam, the turbines spin large generators that produce electricity.

Wind energy

Harnessing wind with large windmills or wind turbines can produce electricity. The rotor blades on these turbines are made out of glass fiber reinforced plastic and resemble airplane wings. The blades must be light because they are so large, typically measuring 25-39 feet in length. Because winds are stronger as you move away from the earth's surface, the rotors are placed on towers that stand 40-70 meters tall. Some houses have smaller wind turbines that can generate enough energy for the household but larger rotor blades are required to generate enough energy for a community.

Modern wind turbines have computers built into them that automatically orient the blades so they can take full advantage of the wind. Rotors are usually designed to rotate and generate electricity when wind speeds are between 5 and 25 meters per second. As the rotor blades rotate they turn a mechanism that is connected to the generator, converting the wind energy into electrical energy.

Nuclear Energy

Nuclear energy is produced using an element called uranium. Like all elements, uranium is made up of atoms. Each atom contains electrons that orbit a nucleus made of protons and neutrons. When a uranium nucleus is hit with a neutron it splits into two atoms in a process called **nuclear fission**. When the atom splits, 2 or 3 neutrons are knocked loose. These loose neutrons then cause other uranium nuclei to split in a domino effect called a **chain reaction**. This reaction gives off an incredible amount of heat energy as well as radiation.

In a nuclear power plant, uranium is collected in long fuel rods and submerged in water to keep it relatively cool. Nuclear fission is controlled so the heat given off in the reaction can be used to boil water and turn it into steam. The steam is then used to drive a steam turbine and turn an electrical generator.

Solar Energy

Solar energy collects the energy from the sun and converts it into electrical energy using **photovoltaic cells** (PV cells). Photovoltaic (photo = light, voltaic = electricity) cells are usually made from a material called silicon. Silicon acts as a **semiconductor** to absorb the energy of the sunlight particles. After the energy is absorbed, the electrons become free.

Half of the PV cell is made up of silicon that is negatively charged and the other half is made up of silicon that is positively charged. This creates an electronic field. The electronic field forces the free electrons from sunlight to move in one direction, toward the positive half of the PV cell. These flowing electrons form an electric current that we can use.

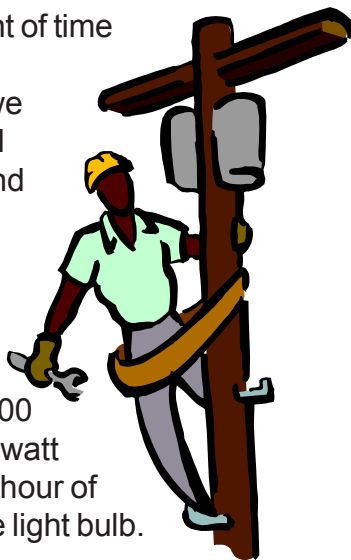
4. What are some of the costs of producing energy?

There are three basic costs that we pay for producing and using energy: 1) economic or monetary costs, 2) environmental costs and 3) social or human costs.

Economic Costs

Utility companies keep track of how much electricity and natural gas a building uses each month with meters. We can see these meters outside of our houses and school and can read them ourselves as well. **Northwest Natural** is the utility company that provides Clark County with natural gas. Natural gas is measured in **therms**. A therm is equal to 100 cubic feet of gas and costs about 99 cents. The average house using natural gas for heat uses about 783 therms each year, spending \$775 for the heating bill. A typical school might use 200 therms each day during the winter months.

Electricity is measured in **kilowatts hours (kWh)**. Everything that uses electricity requires a certain number of **watts** of electrical current to make it work. We must also account for the amount of time that we are using this electrical current, so we measure our electrical usage in both watts and hours. For example, if we leave a 100 watt light bulb burning for 10 hours, then we have used 1000 watt hours of electricity. 1000 watts is equal to 1 kilowatt so we used 1 kilowatt hour of electricity to power the light bulb.



Clark Public Utilities (CPU) is the company that provides residents of Clark County with electricity. CPU charges 7.8 cents for each kWh that you use in your home, which includes a basic service fee. An average house uses 1,500 kWh of electricity each month. Large users of energy, like schools and businesses, also pay a demand charge. This is a charge that is added when customers require large quantities of electricity at one time. The charge covers the costs of new **infrastructure** that is needed during high demand periods.

The price of electricity depends partly on how the energy is produced. Some energy sources like natural gas, coal, petroleum and hydro-power provide a cheap source of electricity. However, if natural resources such as petroleum are nonrenewable, they will become more and more expensive over time as supplies decrease. Other energy sources that use newer technology like wind and solar power are more expensive but the cost of these energy sources is constantly decreasing.

Environmental Costs

The natural resources that we use to produce energy all create some environmental impacts. Some of the ways we produce energy have more negative impacts on the environment than others. We pay for these costs by sacrificing the quality of our environment and the health of the plants, animals and humans that live in this environment.

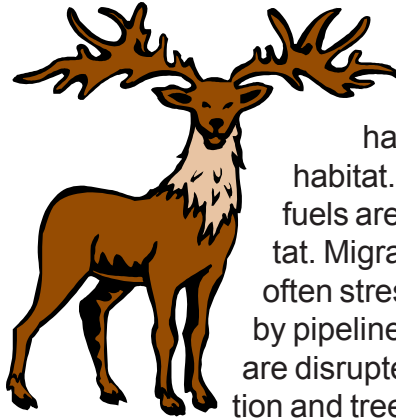
Global Climate Change

The earth's climate has always gone through natural cycles of change. Scientists now agree that some human activities, such as producing energy by burning fossil fuels, are altering our climate on a global scale. When fossil fuels like coal, petroleum and natural gas are burned, they produce carbon dioxide (CO₂) and other **greenhouse gases** as a by-product. CO₂ is a naturally occurring molecule in our air, but since the industrial revolution CO₂ levels in the atmosphere have been increasing dramatically. Excess CO₂ acts like a blanket around the earth, trapping in the heat. This phenomenon is often called the **greenhouse effect**.

Scientists predict that global climate change may cause natural disasters like heat spells, floods, fires and droughts to increase, threatening plants, wildlife and humans. Many scientists believe that many of the changes that we are seeing in the environment today, such as the melting of the polar ice caps, insect break outs and decreased ice pack in the Cascade Mountains are symptoms of climate change.

Water Pollution

There are many ways that generating energy can cause water pollution. Coal plants are the biggest source of mercury pollution in the U.S. Mercury causes harm to wildlife living in these polluted waters, as well as birds, animals and humans who eat fish that are contaminated. Nuclear energy can also create water pollution. Producing energy using nuclear power creates radioactive waste that is harmful and potentially fatal if it is not handled safely. Nuclear waste is buried underground in sealed containers where it remains radioactive. If these waste sites leak or if there is an accident at a nuclear power plant, water can become contaminated with nuclear waste. Manufacturing the photovoltaic cells that are used in producing solar energy also produces some water pollution that can be harmful to wildlife and humans. Drilling and transporting petroleum offshore can also create oil leaks and spills that harm wildlife.



Air Pollution

Burning fossil fuels produces air pollution. Natural gas is relatively clean burning, but coal and petroleum release large amounts of sulfur dioxides and nitrogen oxides. When clouds form, these air pollutants are picked up in the precipitation and fall as acid rain. Acid rain causes harm to fish, animals and trees. Burning fossil fuels often creates smog in urban areas as well. Smog is harmful to breathe, particularly for the elderly, the ill and children.

Habitat Destruction

Using natural resources for energy production can cause natural habitat destruction. Building dams for hydropower dramatically changes the natural river system that it is built on. Damming a river slows the flow, causing some areas to resemble a lake habitat. Plants and animals that have adapted to live in river systems often cannot survive in lakes. Salmon are one species that have been negatively effected by dams in the Pacific Northwest. To complete

their life cycle salmon must travel up and down the river. Dams are a big obstacle for adults to swim past as they head upstream to reproduce and juveniles can be harmed or killed by the dam's turbines as they swim downstream.

Wind farms can effect the habitat of birds and bats. If wind fields are built in regions that are heavily populated by these creatures, like along migratory paths, they can be harmed or killed by the large rotating turbines.

Drilling for petroleum and natural gas as well as building large pipelines for transport can also have negative impacts on wildlife habitat. Many of the areas where these fuels are found contain very fragile habitat. Migrating animals such as caribou are often stressed because they are blocked by pipelines. Other animals like polar bears are disrupted by drilling. Sometimes vegetation and trees are destroyed in rainforests to allow for natural gas drilling. Mining for coal is also very harmful for wildlife habitat. Many times entire mountain tops are removed to access coal deposits, leaving the land inhabitable for wildlife.

Social Costs

Some social costs are directly related to environmental costs. Humans cannot be healthy without a healthy environment to live in. Every living creature, including humans, need clean air and water. Smog that is concentrated in cities can have harmful health effects on the young, elderly and ill. Water pollution, such as mercury poisoning, often builds up to dangerous levels in fish. Children and pregnant women are particularly harmed if they eat fish contaminated with mercury.

Social costs can impact human health in other ways as well. Coal miners may get caught in cave-ins or develop black lung disease and other respiratory problems. Workers at nuclear power plants and communities near these plants risk being exposed to harmful radiation if sabotage or an accidents occurs.

Sometimes social costs involve conflicting interests or needs. Native Americans have lost many of their traditional fishing grounds since dams have been built. Often when a large dam is built, people who have lived in the river valleys for centuries are forced to move or they will be flooded when the reservoir is formed. Some nuclear sites are located near Native American's sacred lands. Sometimes there are conflicts or wars over natural resources that are used for energy, such as petroleum.

5. Why is energy conservation important and how can we conserve energy?

The Importance of Energy Conservation

There are three main reasons why energy conservation is so important: 1) Energy costs money. The more energy we save, the more money we have to spend on other things. 2) Producing energy has countless environmental and social impacts. The more energy we conserve, the less we will harm the environment, wildlife and ourselves. 3) Producing energy uses natural resources, some of which are nonrenewable. The more energy we save, the longer these resources will last.

Energy Conservation and Efficiency

There are two basic ways that we can reduce the amount of energy that we use. **Energy conservation** involves the behavioral choices that each of us make everyday. Some energy conservation behaviors may include turning off lights, taking shorter showers, car pooling, and wearing warmer clothes in the winter time. These are small things that we can all do to make a difference. **Energy efficiency** focuses on using technology to decrease the amount of energy we use without necessarily changing our behavior. Some things that we can do to be more energy efficient include using compact fluorescent light bulbs, wrapping the hot water heater with quality insulation, driving a hybrid electric car and using more energy efficient appliances and electronics.

6. Where do the natural resources used to produce energy come from?

When using natural resources, it is important to consider sustainability. Part of using natural resources in a sustainable way is understanding where the resource comes from and how available it is now and will be in the future. Some resources are able to replenish themselves through natural processes, as long as we use them wisely. Other natural resources have a limited supply and are nonrenewable.

Natural Gas

Natural gas is often called a fossil fuel because of the way it was formed. When bacteria feed on dead organic matter like plants and animals, the materials **decompose**, giving off methane gas as a by-product. Natural gas is composed primarily of this methane gas.

The process of decomposition occurs today when food is digested in your stomach and garbage or compost rots, but the natural gas that we use for energy was formed 65 million years ago when dinosaurs walked the earth. When plants died long ago they were slowly covered with earth and as the material decomposed, natural gas was trapped underground. We can drill down to these deposits and extract the natural gas for use.

After drilling, natural gas is compressed into a nontoxic, odorless and colorless liquid that is stored in underground reservoirs. In 1979 natural gas was discovered in Mist, OR, about 80 miles southeast of Vancouver. Natural gas is a nonrenewable resource so over time this reserve started to become depleted. Because natural gas has no way to replenish itself, we made arrangements to pipe in gas from Canada and Alaska. But these supplies are limited too. We now use the reservoir in Mist as a storage tank to hold the natural gas imports. When natural gas is needed it is decompressed back into a gas, an odorant is added for safety and it is piped to local communities.

Coal

Coal is also considered to be a fossil fuel. Coal like natural gas is a nonrenewable resource. The deposits that we use today were formed in special circumstances millions of years ago by the decomposition of organic materials. The heat and pressure beneath the earth's surface compressed the decomposing material, creating coal. Most of the world's coal reserves are found in Russia, China and the United States. Although we do not use coal in Clark County, there are other counties near by who do use coal for an energy source.

Petroleum

Like natural gas and coal, petroleum is a fossil fuel that was formed long ago through decomposition and is therefore a nonrenewable resource. There are a limited number of petroleum reserves, many of which are found below the ocean floor or in fragile habitat, so once we use the earth's petroleum, we will not get any more. Petroleum is one of the components of crude oil. Unlike natural gas, petroleum must be refined in factories before it can be used. The largest crude oil reserves are found in countries in the Middle East such as Saudi Arabia, Iraq, Kuwait, Iran and the United Arab Emirates.

Wind

Wind is moving air created by variations in temperature and pressure on the earth's surface. The sun heats the earth unevenly, creating temperature differences. Areas that are heated more have a higher air pressure while areas with cooler temperatures have a lower air pressure. Air moves from areas of higher pressure to areas of lower pressure, creating gusts of wind. The greater the difference in pressure, the faster the speed of the moving air.

Some regions are naturally more windy than others so harnessing wind energy from these regions is more economical. In the United States wind energy is used widely in California Colorado and Texas. Other countries such as Denmark, Germany and Spain also use wind

power to generate electricity. Wind can be considered to be a perpetual resource because it will continue to replenish itself regardless of how we may use it as an energy source.

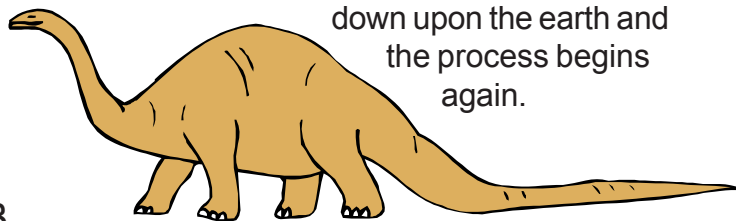
Solar

Solar power is sun energy. The sun is a big ball of burning hydrogen. Radiation from the sun provides energy for all the processes that occur on earth. The sun powers the water cycle, creates winds, dictates climate and allows plants and animals to live, just to name a few of these processes!

The sun is a perpetual resource because as long as there is life on earth, the sun will be burning. When we harness solar power, we are not depleting the sun's energy. Although the sun's energy is constantly radiating upon the earth, there are times when not as much energy reaches the earth's surface. During the night and when the skies are overcast solar radiation decreases. There are some regions on earth where solar energy is more readily available. The western and southern regions of the United States receive a more consistent supply of solar energy than the rest of the country.

Hydropower

Hydropower comes from water. As water runs toward the ocean through streams and rivers, it contains a lot of kinetic energy. The hydropower that we use to generate electricity in Clark County comes from a series of dams along the Columbia River system which hold the water back, creating potential energy until we are ready to use it. Water can be considered a renewable energy resource. After rain gathers into streams and streams gather into rivers and rivers reaches the ocean, the water cycle allows water to renew this process through evaporation. After the water evaporates from the ocean, clouds form, precipitation comes down upon the earth and the process begins again.



Nuclear

Nuclear energy comes from a special type of uranium called uranium 235. Uranium is a **radioactive** element that is formed in stars. When old stars exploded long ago, the dust came together to form planets, including Earth. When the earth was formed, uranium contained in these stars was deposited on our planet.

Uranium is nonrenewable, so the amount of uranium that was deposited when the earth was formed is all the uranium we will ever have. In fact, because uranium is radioactive, it slowly decays. Uranium 235 decays faster than other types of uranium and as a result it is more rare.

Looking Into the Future

As the nonrenewable resources that we depend on for our energy decrease over time, we will begin to depend more on other resources. Renewable and perpetual resources give us an opportunity to generate energy in a sustainable way, but even these resources come with some costs. Part of choosing an energy source that can be used sustainably involves balancing the benefits and costs. No matter which energy sources we use now or in the future, energy conservation is the best way we can limit our impact on the earth and our environment.

ENERGY SOURCE	BENEFITS	DOWNFALLS
Natural Gas	-cleaner than other fossil fuels -relatively inexpensive	-nonrenewable resource -air pollution -global climate change
Wind	-perpetual resource -no air pollution -no water pollution	-noise/scenery impact -some harm to wildlife
Nuclear	-no air pollution -little land disruption	-nonrenewable resource -very expensive -radioactive waste hazards -deadly accidents/sabotage
Coal	-currently widely available -relatively cheap -easy to transport	-nonrenewable resource -habitat destruction -mining hazards -water pollution, acid rain -air pollution -global climate change
Hydropower	-renewable resource -relatively cheap -no air pollution -no direct water pollution	-habitat destruction -harmful/threatening to wildlife -limited dam sites -expensive infrastructure
Solar	-perpetual resource -no air pollution -easy to install/maintain	-currently expensive -not available at night -some water pollution

MORE THAN MONEY CAN BUY

OVERVIEW:

Students play a survey-style interactive game to reflect upon their energy use habits at home and at school. Throughout the game students will learn that there are real world costs associated with producing the energy that we depend on each day.

SKILLS:

reading

DURATION:

30-55 minutes

MATERIALS:

28 survey cards
28 energy impact cards
earth cards
1 earth
1 garbage can
carpet square

OBJECTIVE:

Students will understand that in addition to economic costs, there are social and environmental costs associated with producing energy for our use. Students will identify some activities that use excessive energy and recognize alternatives that promote conservation.

EALR CONNECTIONS:

Science

- 1.2 • *energy sources and kinds*
- 1.3 • *processes and interactions in the earth system*
- 1.3 • *interdependence of life*
- 1.3 • *environmental and resource issues*

Geography

- 3.1 • *interaction with and impact on the environment*
- 3.2 • *analyze how the environment and environmental changes affect people*

Reading

- 1.2 • *read fluently, adjusting reading*

Communication s

- 2.3 • *use effective delivery*

Health

- 3.1 • *understand how environmental factors affect one's health*

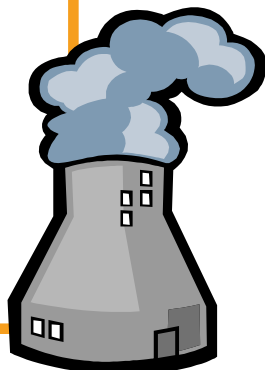
Arts

- 1.3 • *solve problems and express ideas*

PROCEDURE:

INTRODUCTION

1. Have students brainstorm some of the ways that we use energy in our homes and at school. You may do this as a class or break them into small groups.
2. After students are satisfied with their list, gather them together and create a seated circle, either on the floor or at a table. Point out how much energy we all use each day and tell students that they will be playing a game about energy conservation.
3. Ask students why they think it's important to learn about conserving energy. Some students may mention that conserving energy helps save money.



Students may mention that energy conservation also helps save the earth. Place the earth in the circle, and ask students what “saving the earth” means. Place half of the clean water, clean air, habitat, animal and human cards on the earth as students mention them.

Explain that in addition to money, the price we pay for energy can be seen in the way we impact our earth. Producing energy can pollute our water and air, destroy natural habitat, threaten wildlife survival and even compromise our own health. Place the garbage can in the circle with the remaining earth cards.

4. Randomly distribute the energy impact cards to students. They may look at their own cards if they wish. Explain that these cards describe some of the ways that producing energy can effect the earth or humans directly. We will see during the activity how our choices can lead to various consequences.

DOING THE ACTIVITY

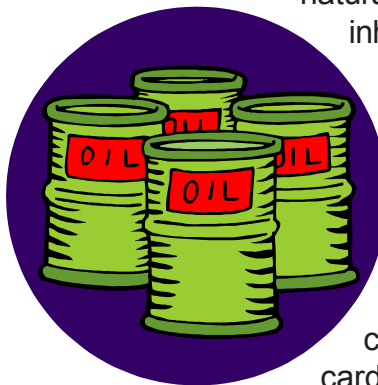
1. Before you begin the activity be sure to briefly explain the objective of a survey: Surveys are not tests; there are no correct answers.

Students will take turns asking survey questions to one another. Students will probably be able to determine the choices that promote energy conservation, but this is not the primary objective of the activity. Rather, students should answer survey questions honestly to gain insight on how they and others can improve their energy conservation practices.

2. Choose a student (A) to randomly draw a survey card from a deck or pile of the cards. This student should read the orange side of the card aloud to her classmates then choose a friend (B) to answer the question. Recruit other students to help determine if the question is answered honestly!

3. After student (B) answers the question, student (A) will flip the survey card over and read the yellow side aloud to determine which activity uses more energy. The card will also state what type of natural resource was used to produce energy for this activity.

4. Choose a student (C) with an energy impact card that matches up with the natural resource sited on the survey card. Have Student (C) read the card aloud to the class to explain how using this natural resource may effect our earth, its natural resources and inhabitants.



The class will then determine the consequences associated with the activity’s impact; they may have to infer some of the consequences from the card. For example, if water pollution is an impact students may also infer that habitat is destroyed and animals and humans are harmed since humans and animals need clean water to drink and in some-times for habitat.

5. If student (B) chose the activity that conserves energy he should move the relevant earth cards (1 each) from the garbage can to the earth. If he choose the activity that uses more energy he should move the earth cards (1 each) from the earth to the garbage can.

6. Collect survey questions and energy impact cards in a discard pile, then have Student (B) draw and read the next question to a new friend. Continue in this fashion until all the cards are read or all students have taken a turn.

7. If all the earth cards end up in the garbage can or all the money cards end up in the mailbox acknowledge the problem and relate it to real life if possible. For example, all of the animal cards ending up in the garbage can may reflect an extinct species. Luckily in this game we can get them back. Likewise, paying the utility bills can be a big obstacle for many families. In the reverse case, if all of the pieces are on the earth and piggy bank, encourage students to keep up the good work!

FOLLOW-UP

1. To review some of the ways that producing energy can impact the earth and our own lives you may have students create signs to place strategically around the school as reminders to promote energy conservation.

2. Begin by brainstorming some of the daily activities the class can recognize that waste energy in your school. Create a list as a class. Some activities may include leaving the lights on in classrooms during lunch time, opening the windows while the heat is on, busses idling in the parking lot or not having recycling bins set up in convenient locations.

3. Next students should choose an activity from the list where they think a behavior change is possible. They may work in small groups or individually, either in class or as a homework assignment. Have students create an eye-catching sign that encourages both students and staff to conserve energy by targeting a specific activity or behavior.

Signs should include graphics as well as a catchy phrase addressing the behavior change and an impact that they learned through the activity.

For example:



HILLS OF BILLS

OVERVIEW:

Students will analyze a realistic electrical bill to see the actual monetary cost of running a school. In addition to monetary cost, students will take a closer look at the cost associated with producing energy to gain an understanding of the environmental and social costs that do not appear on utility bills.

DURATION:

Activity: 30-40 minutes

VOCABULARY:

MATERIALS:

Electrictown Public Utilities
The Cost of Energy cards
calculators

OBJECTIVE:

Students will see firsthand that there are real world costs associated with producing and using energy and will take steps to reduce their electricity use.

EALR CONNECTIONS:

Math

- 1.1 • *understand and apply concepts and procedures from number sense*
- 4.1 • *gather information*
- 4.2 • *organize and interpret information*
- 5.3 • *relate mathematical concepts and procedures to real-life situations*

Science

- 1.2 • *energy sources and kinds*
- 1.3 • *interdependence of life*
- 1.3 • *environmental and resource issues*

Geography

- 3.1 • *interaction with and impact on the environment*
- 3.2 • *analyze how the environment and environmental changes affect people*

Reading

- 3.2 • *read to perform a task*

Health

- 3.1 • *understand how environmental factors affect one's health*

PROCEDURE:

SETUP

1. Pass out an Electrictown Public Utilities electric bill to each student, making sure they have side one facing up.

DOING THE ACTIVITY

1. Complete side one as a class, encouraging student participation. Students will need calculators for math operations. Notes from the energy presentation may be helpful as well for answering questions about environmental and social impacts associated with generating electricity.
2. After side one is complete you may have a brief discussion about what the students have learned from the bill. Were they surprised how expensive it is to provide a school with electricity? Do they have suggestions for reducing electrical usage by 5%?



3. Answer any questions students have about calculating the bill before moving on to side two of the worksheet., then divide students into 5 groups and give each group a copy of *The Cost of Energy*. Allow them to choose which natural resource they would like to generate their energy from after studying the handout.



THE COST OF ENERGY

NATURAL GAS

Price: 7 cents/kWh

Selling Points: Natural gas burns cleaner than other fossil fuels and is relatively inexpensive

Downfalls: Natural gas is a nonrenewable resource and burning it produces air pollution and contributes to global climate change. Drilling for natural gas can cause destruction to wildlife habitat and threaten the lives of plants and animals that live in those habitats.

SOLAR

Price: 15 cents/kWh

Selling Points: Solar energy is a perpetual resource that produces no air pollution.

Downfalls: Producing the solar panels used to collect the energy in sunlight produces some water pollution and energy cannot be generated at night.

HYDROPOWER

Price: 4 cents/kWh

Selling Points: Hydropower is a renewable resource that produces no air pollution and no water pollution.

Downfalls: Dam sites are limited and expensive to build. Building dams dramatically alters land and aquatic wildlife habitats. Dams threaten the lives of fish and other plants and animals. Sometimes creating reservoirs behind dams forces large communities living in river valleys to move. Dams have destroyed most of the Native American's traditional fishing grounds.

4. Each group should work together to complete side two of their worksheets, using side one as a reference.

FOLLOW-UP

1. After all groups have completed their worksheets, discuss how they choose which energy source to use and if they were happy with their decisions.

WIND

Price: 6 cents/kWh

Selling Points: Wind is a perpetual resource that produces no air pollution and no water pollution.

Downfalls: Windmills create some noise and can harm birds and require new infrastructure to be built.

COAL

Price: 4 cents/kWh

Selling Points: Coal is currently widely available and easy to transport.

Downfalls: Coal miners can develop black lung disease or be killed by explosions and cave-ins. Mining for coal causes wildlife habitat destruction and reduces water quality, threatening plants and animals. Burning coal releases chemicals that create acid rain and water pollution. Burning coal also creates air pollution and smog that is harmful to human health and contributes to global climate change.

NUCLEAR

Price: 6 cents/kWh

Selling Points: Nuclear energy produces no air pollution and has little land disruption.

Downfalls: Nuclear plants produce radioactive waste that is hazardous to living things. We have no safe way to dispose of this waste and it can contaminate water. Accidents or sabotage at nuclear plants can release deadly radiation into communities. Mining uranium can be hazardous to workers.

HILLS OF BILLS

Name: _____

Side 1

Your Electricity Use

Electricity generated by: **Natural Gas and Hydropower**

GENERAL SERVICE ELECTRIC METER 8713

In 31 days you used 646200 kWh and 1782 kW

Present reading - 04/16-04 6059 kWh

Previous reading - 03/16/04 - 5736 kWh

Meter reading difference 359 kWh

Meter multiplier $\times 1800$

(a) Total electric usage 646200 kWh

Demand Charge:

Total demand (kW) 1782 kW

Your charge for 646200 kWh is:

(e) Basic service \$30.00

1782 kW @ \$5.00 \$8,910.00

(d) 646200 kWh @ 7.8 cents each \$50,403.60

(c) Total electric service \$59,343.60

Your average daily cost was \$1,914.31

**Electrictown
Public
Utilities**



Compare Your Use

ELECTRIC METER 8713

SERVICE TO	kWh USED
04/16/04	633280
03/16/04	691490
02/13/04	723240
01/18/04	947270
12/14/03	852010
11/13/03	483340
10/23/03	754990
10/15/03	458640
08/15/03	375730
07/13/03	389840
06/16/03	617400
05/16/03	603290 (b)

(f) Additional Costs:

- How many **kWh** of electricity did this school use during the **month**? _____
- How many **kWh** did the school use in one **year**? _____
- How much **money** did the school spend on electricity this **month**? _____
- How much **money** has this school spent on electricity for the entire **year**?
(hint: first determine how much each kWh costs) _____
- What else is the school **charged** for on this bill besides the number of kWh used?

- What are some of the **additional costs** (impacts) of generating energy with this resource that are not printed on the bill? (see **The Cost of Energy**) List these costs in the space above.
- If this school reduced it's electricity use by **5%** next month, how much money would it **save**? (assume other charges (e.) are the same)

Your Electricity Use

Electricity generated by: _____ ①
GENERAL SERVICE ELECTRIC METER 8713

In 31 days you used 646200 kWh and 1782 kW

Present reading	- 04/16-04	6059 kWh
Previous reading	- 03/16/04	- 5736 kWh
Meter reading difference		359 kWh
Meter multiplier		<u>x 1800</u>
Total electric usage		646200 kWh

Demand Charge:

Total demand (kW)	1782 kW
-------------------	---------

Your charge for 646200 kWh is:

Basic service	\$30.00
1782 kW @ \$5.00	\$8,910.00
646200 kWh @ _____ ② cents each = \$	
Total electric service ③ \$	

**Electrictown
Public
Utilities**



Compare Your Use

ELECTRIC METER 8713

SERVICE TO	kWh USED
04/16/04	633280
03/16/04	691490
02/13/04	723240
01/18/04	947270
12/14/03	852010
11/13/03	483340
10/23/03	754990
10/15/03	458640
08/15/03	375730
07/13/03	389840
06/16/03	617400
05/16/03	603290

⑤ Additional Costs:

- Which **energy source** are you using to generate your electricity? _____
- What is the average **cost per kWh** for the energy source you chose? _____
- How much **money** did your school spend on electricity this **month**? _____
- How much **more** or **less expensive** is your energy bill, compared to the first bill?

- What are some of the **additional costs** (impacts) of generating energy with this resource that are not printed on the bill? (see **The Cost of Energy**) List these costs in the space above.

- If you had the choice, would you rather pay **more money** and less additional costs or **less money** and more additional costs for your electricity? Why?

- How could you pay less **money** for electricity and lower the environmental **impacts**?

GLOSSARY

adaptation: Evolutionary changes that allow populations to be better able to exist under prevailing environmental conditions.

aquifer: Any active body of porous rock that is capable of producing water.

bioswale or biofilter swale: A shallow stormwater feature similar to a man-made wetland near parking lots.

catch basin: *see storm drain*

Ccf: A measurement used for quantifying the amount of water equal to one hundred cubic feet.

Central Transfer & Recycling:

chain reaction: A reaction in which the products of one stage facilitate the next stage, making the process self-sustaining.

combined-cycle combustion turbine: An electrical generator that uses more than one source of energy (e.g. natural gas heat and steam) in combination to turn a series of curved vanes on a rotating shaft

compost: A mixture of decaying organic matter used to add structure to soil and increases its ability to hold water and nutrients and allows roots to grow through it easily

decomposition: The process by which organisms break down, rot or decay.

ecological footprint: An accounting tool for sustainability which measures of the amount of productive land and water area that is required to indefinitely satisfy the existing resource consumption of a given human population using prevailing technology.

energy: The capacity to perform work

energy conservation: Reduction in consumption of energy accomplished through cutting back on energy use or increasing the efficiency of energy use.

energy efficiency: The percentage of the total energy put into a system that can be converted into useful work and not lost as unproductive heat.

Finley Buttes Landfill: A modern sanitary landfill located near Boardman, Oregon where Clark County disposes of its solid waste through compaction and burial.

fluorescent bulb: A lamp consisting of a glass tube whose inner wall is coated with a material that fluoresces (emits electromagnetic radiation, especially light) when bombarded with secondary radiation generated within the tube.

greenhouse effect: Heating of the earth's atmosphere that is loosely analogous to the glass of a greenhouse letting light in but not letting heat out.

greenhouse gases: Those gases in the earth's atmosphere that contribute to the greenhouse effect.

global climate change: An increase in the average temperature of the earth's atmosphere, especially a sustained increase sufficient to cause climatic change.

hazardous waste: Solid wastes that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may pose a substantial hazard to human health or the environment when improperly treated, disposed, or otherwise managed

impermeable: Not permitting water or another fluid to pass through

impervious surface: A layer of material through which water does not pass

incandescent bulb: An electric light bulb in which a filament is heated to emit visible light by an electric current

infrastructure: All of the permanent, engineered and constructed portions of a community such as the highways, bridges and storm sewers.



interdependent: Describing the condition in which different elements in any system interact and depend on each other, as opposed to being completely separate or having a one-way relationship.

kilowatt: One thousand watts (see watt)

kilowatt demand: The highest number of kilowatts needed during any 30 minute period

kilowatt hour (kWh): a unit to measure electrical energy equal to the energy delivered by 1000 watts during one hour, or 3.6 million joules

kinetic energy: The energy of mass in motion.

law of conservation of energy: A fundamental principle of physics stating that the amount of energy within any isolated system, including the universe, is always constant. Energy can neither be created nor destroyed but only changed into a new form.

leachate: Liquid that percolated or leaked through solid waste or another medium and has extracted, dissolved, or suspended materials from it, which may include potentially harmful materials. Leachate collection and treatment is of primary concern at municipal solid waste landfills.

materials recovery facility: A permitted solid waste facility where solid waste or recyclable materials are sorted by hand or mechanically for the purpose of separating or compacting

methane: A colorless, odorless, flammable, and explosive gas present in natural gas and formed by the decomposition of organic matter. Natural gas is nearly pure methane.

microorganism: An organism that can only be seen with the aid of a microscope.

Northwest Natural: A utility company that provides most residents Clark County and neighboring counties with natural gas

nuclear fission: The splitting of a heavy isotope into two or more lighter elements, in a process which releases large amounts of energy.

organic: Material derived from decaying organic molecules of natural organisms (the remains of plants and animals).

organic fertilizer: Plant fertilizers directly derived from natural sources (usually from living matter), as opposed to inorganic fertilizers made of synthesized chemicals. Plants grown with organic fertilizers are labeled organic.

permeable: A layer of material through which water can pass.

photovoltaic (PV) cell: A device that converts sunlight or other radiant energy directly into voltage.

potential energy: Energy stored in a substance or a body because of its position or state, rather than its current motion.

radioactive: material exhibiting radioactivity (the property of emitting subatomic particles and electromagnetic radiation), either natural or artificially induced.

radioactive waste: Waste material sufficiently radioactive to be of concern.
radioactivity:

recycle: To collect and to reprocess a resource so that it can be made into new products, such as salvaging bottles or aluminum cans for processing into new bottles or cans. Recycling differs from reuse by involving reprocessing.

reuse: Using a resource again in its original form, as in washing and refilling a container.

runoff: Precipitation that flows over land to rivers, lakes and streams

sanitary landfill: A specially engineered (designed and constructed) site for disposing of non-hazardous solid waste on land. The site is constructed so that it will reduce hazards to public health and safety. Under federal law, a sanitary landfill must have an impermeable lower liner to block the movement of leachate into ground water, a leachate collection system, gravel layers permitting the control of methane, and other safeguards. Waste is spread in layers, compacted to the smallest practical volume, and covered at the end of each operating day.

semiconductor: A material having a greater ability to conduct than an insulator, but not as great an ability as a conductor such as a metal. Silicon is the best known material form semiconductors and is used to generate electricity from sunlight.

square foot: a measurement of area over a 2-dimensional surface, roughly 12" x 12"

solid waste: garbage, refuse, sludges, and other discarded solid material including those from residential, industrial, commercial, and agricultural operations, and from community activities.

sort line: Area where materials are separated into specific categories, often utilizing a conveyor belt or equipment to move the material in a linear direction

storm drain (catch basin): The sloping feature over an impervious surface where water gathers to flow down a stormdrain

stormwater: Runoff from impervious surfaces; rain water

sustainability: Using natural resources in a way that meets the needs of the present without compromising the ability of further generations to meet their own needs

thermostat: A device that maintains the temperature at an established level

therm: The number of cubic feet of natural gas consumed multiplied by the cost of providing the gas at a constant pressure

transfer station: A place or facility where waste materials are taken from smaller collection vehicles (e.g. garbage or compactor trucks) and placed in larger transportation units (e.g. tractor trailers, shipping containers, or barges) for movement to disposal area, usually landfills. Transfer stations may include recycling facilities.

turbine: A machine driven by the pressure of a current of fluid such as water or steam and producing rotary motion direction

vermicompost: The use of worms, usually red wigglers to digest organic waste

watt: A measure of electrical energy equal to the voltage multiplied by the current.

yard debris: Organic material that can be collected and composted such as leaves, grass clippings and twigs.

ENVIRONMENTAL EDUCATION RESOURCES

*This list was compiled by the Environmental Information Cooperative.
Updated 8/15/01.*

<http://www.vancouver.wsu.edu/vis/lib/html/envre.htm>.

American Water Works Association

<http://www.awwa.org>

Information and resources about drinking water. Events, technical resources, publications, products, utilities, jobs, and links about water resources and safe drinking water.

Amazing Environmental Organizations Web Directory

<http://www.webdirectory.com/>

Large and easy search engine. Links to various environmental topics, products, companies, magazines, and related subjects. Includes environment bulletin board.

The Chemical Scorecard

<http://www.scorecard.org>

A chemical information service. Makes it easy to find information fast: where these chemicals come from in your community, what their known or suspected effects are, and what actions you can take.

Clark County Master Composter/Recycler Program

<http://clark.wsu.edu/volunteer/mcr/index.html>

Earth Island Institute: Innovative Environmental Activism to Protect Our Earth

<http://www.earthisland.org>

In-depth information and resources to address environmental challenges.

Educating Young People About Water

<http://www.uwex.edu/erc/ywc>

Descriptions of community youth water education programs and materials. Links to related organizations and programs.

Environmental Education Link (EE Link)

<http://nceet.snre.umich.edu/>

<http://www.eelink@eelink.umich.edu/>

<http://www.eelink@eelink.umich.edu/activities.html#water>

Resource for students, teachers, and professionals who support K-12 environmental education. Led by the University of Michigan and U.S. EPA, this is a program of the National Consortium for Environmental Education and Training. From here you can find green databases, organizations, classroom tools, and other resources.

Environmental Information Cooperative

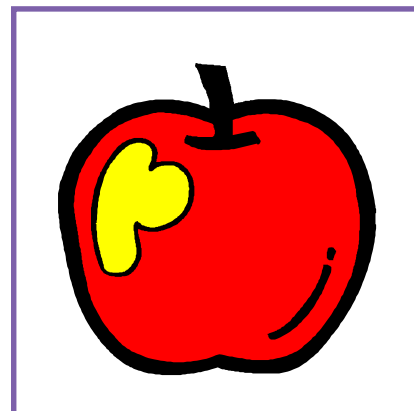
<http://griffin.wsu.edu/search~/>

The EIC is a local

EnviroLink

<http://www.envirolink.org>

EnviroLink is a nonprofit organization, a grassroots online community that unites hundreds of organizations and volunteers around the world with millions of people in more than 150 countries. Provides comprehensive, up-to-date resource



Environmental Protection Agency

<http://www.epa.gov/epahome>

<http://www.epa.gov/ecosystems>

EPA programs. The second address is about community-based environmental protection: promoting sustainable ecosystems and communities.

Environmental Email Lists from the EPA

Enviro-Newsbrief: a daily list of news summaries from the New York Times, Wall Street Journal, Washington Post, and others. To subscribe, send a message to: listserv@unixmail.rtpnc.epa.gov with the following in the body of the message: subscribe environb-I FIRSTNAME LASTNAME where FIRSTNAME is your first name, and LASTNAME is your last name.

Internet-Newsbrief: a weekly list of descriptions of Internet sites with environmental subject material. To subscribe, use the same method as above, except the body of the message should read: subscribe internetnb-I FIRSTNAME LASTNAME.

Environmental Protection Agency Index of Watershed Indicators

<http://www.epa.gov/iwi>

Compilation of information on the health of aquatic resources in the United States. Index looks at a variety of indicators that point to whether rivers, lakes, streams, wetlands, and coastal areas are well or ailing and whether activities on the surrounding lands that affect our waters are placing them at risk.

Environmental Recycling Hotline

<http://www.1800cleanup.org/>

Database of recycling centers nationwide. Type in your zip code to find local locations for disposal of hazardous wastes, as well as pointers on where to purchase recycled products.

Evergreen Foundation

<http://www.evergreen.ca>

A Canadian site that is a comprehensive resource with step-by-step planning information, articles from their newsletter and reports from schools that have undertaken schoolyard restoration projects and turned school grounds into natural learning environments.

For the Sake of the Salmon

<http://www.4sos.org>

Includes information on watershed restoration and protection, education, funding, and other topics. Lists of watershed groups in the Pacific Northwest. Watershed links and newsletters.

Global Change Master Directory

<http://gcmd.gsfc.nasa.gov>

Comprehensive interdisciplinary directory of Earth and environmental data. Helpful for searches for meteorological, geological, oceanographic, ecological, hydrological, or remote sensing data. Features over 650 data centers, research institutions, universities, and federal agencies from the U.S.A. and around the world. Provides summary information about the data so you can decide on the usefulness and relevance of a particular existing dataset.

Global Recycling Network

<http://grn.com/>

Its goal is to become a one-stop solution for recycling information for businesses, consultants, researchers, students, and consumers. It is also helping to develop the international trade of recyclable goods. A business directory and info library are some of the resources here. A Long Island, N.Y., group.

Green Page: A Guide to Things Environmental on the Internet

<http://www.echonyc.com/~kamml/>

It's a plainly presented, annotated collection of links to a diverse bunch of sites, gopher sites, usenet sites, organizations, and other resources. Greenpeace, Sierra Club, Wilderness Society, Green parties, Earth-First newsgroup, and many others can be found here.

Green Seal—Homepage

<http://www.greenseal.org>

Green Seal is an independent, nonprofit organization dedicated to protecting the environment by promoting the manufacture and sale of environmentally responsible consumer products. Sets standards for products.

Ground Water On-Line

<http://www.ngwa.org>

The National Ground Water Association web site offers a database containing more than 78,000 ground water literature citations with key words, abstracts, chemical compounds, biological factors, geographic locations, authors, titles, publication source names, and more. Indexed documents include scientific, technical, and trade journals; newsletters; books; government documents; university reports; dissertations and theses; state publications; and proceedings of national and international conferences and symposia.

Hazardous Waste Clean-Up Information (CLU-IN)

<http://clu-in.org>

Provides information about innovative treatment technologies to the hazardous waste remediation community. Describes programs, organizations, publications, and other tools for federal and state personnel, consulting engineers, technology developers, and vendors, remediation contractors, researchers, community groups, and individual citizens. Site is managed by EPA's Technology Innovation Office and is intended as a forum for all waste remediation stakeholders.

Hortsense (Pacific Northwest Plant Problems)

<http://www.pep.wsu.edu/hortsense>

Horticultural plant problems and pest management solutions for the Pacific Northwest. Consists of both non-chemical and pesticide suggestions for 800 problems common among 80 yard and garden plants grown in the Pacific Northwest (ornamentals, small fruits, tree fruits, turf, vegetables, and weeds). Home gardener fact sheets for managing plant problems with integrated pest management.

ICLEI Home Page

<http://www.iclei.org>

The International Council for Local Environmental Initiatives is an association of local governments dedicated to the prevention and solution of local, regional, and global environmental problems through local action.

Internet Consumer Recycling Guide

<http://www.obviously.com/recycle>

Get some straightforward information on recyclable materials, including those that are difficult but not impossible to recycle, and where the recycling resources in your community might be. Intended for regular folks with household quantities of materials to recycle. Includes a comprehensive recycling guide, instructions how to reduce junk mail, a directory of recycling centers, recycling prices, and instructions how to make recycled paper.

Journey North

<http://www.learner.org/jnorth>

A global study of wildlife migration. Program follows spring northward migrations of a number of species. This is an Annenberg/CPB Math & Science Project program. Includes news, reports, teacher's manual, teacher discussion, and on-line orientation.

Kids Gardening

<http://www.kidsgardening.com/>

A site within the National Gardening Association, a nonprofit organization, which focuses on children and the ways that gardening enhances education and helps build environmentally responsible adults. Primary efforts include the Web site Kidsgardening.com, a place where teachers, parents, and community organizers can find gardening resources; GrowLab: Activities For Growing Minds, a curriculum utilized in classrooms across the country to help students learn about science and the environment; Gardening With Kids catalog, a resource packed with educational tools to make learning fun; and Youth Garden Grants, a program that provides valuable grants of gardening tools and supplies awarded annually to schools, youth groups, and community organizations.

KOIN Weather Station

<http://weather.channel6000.com/index.cfm>

Portland, Oregon, and Vancouver, Washington, weather reports. Includes national weather, maps, ski reports, and almanac.

Let Earth Speak

<http://www.pacificrim.net/~nature/earthday.html>

Here's an eco-psychology activity created by Friday Harbor-based Project NatureConnect for Earth Day.

Lower Columbia Fish Recovery Board (LCFRB)

<http://www.lcfrb.gen.wa.us>

The LCFRB is responsible for implementing the habitat portion of the approved steelhead recovery initiative that must include a monitoring component. On this site you can find information on watershed planning, restoration of ESA-listed salmon, steelhead and other fish species in the lower Columbia, habitat restoration projects, downloadable graphics, and web links to teacher resources and program related agencies and organizations.

National Agricultural Library

<http://www.nal.usda.gov/wqic/>

Databases and topics about water resources and agriculture. Also, what's new, meeting lists, educational resources, enviro-news, and progress reports.

National Drinking Water Clearinghouse

http://www.estd.wvu.edu/ndwc/ndwc_homepage.html

Covers drinking water issues. Includes abstracts of their newsletter (On Tap) and Water Sense and information in their library. The site also includes links to numerous agencies and programs, research libraries, and groundwater and wastewater information sources.

National Geographic

<http://www.nationalgeographic.com/education/>

Provides information and resources for K-12 teachers, including maps, online adventures and lesson plans in geography, science, social science, reading and writing and a search site for past and current publications.

National Oceanic & Atmospheric Administration (NOAA)

<http://www.noaa.gov/>

The Home site offers news and information on current weather watches and warnings, ocean conditions, real-time satellite imagery, global warming, climate predictions, air quality, and links to other environmental websites. Jump to their Education Resource site designed for teachers, students, and others interested in weather, climate change, oceans and coasts, satellites and space.

National Wildlife Federation

<http://www.nwf.org>

Click on the "Education" site for information on Backyard Wildlife Habitat and Schoolyard Habitat programs, the "Kid's Zone" site has online games, virtual tours and outdoor activities. Current information on Keep the Wild Alive programs that deal with protecting wildlife, wild places and natural resources, can be found on "Wildlife Work". NWF has teamed up with eNature (www.eNature.com) to offer some of the most extensive wildlife habitat information on the Internet. Visitors can enter their zip code, or the zip code of a vacation destination, and receive a free customized photographic guide to the wildlife of the area thanks to the most extensive field guide information available on the web. The collection includes species lists for all of the more than 42,000 zip codes in the continental United States and Alaska. The site also enables visitors to hear the calls of more than 500 birds and to identify and discover the habitat needs of a wide array of wildlife.

National Council for Science and the Environment (NCSE)

<http://www.cnie.org>

The NCSE, a neutral science-based organization, works to improve the scientific basis for environmental decision making and emphasizes an approach to environmental science that integrates interdisciplinary research; scientific assessment; communication of science-based information to decision makers and the general public; and environmental education. This site includes research service projects, population and environmental links, educational programs and resources, ecology and biodiversity library, environmental laws and treaties, and more. DHEEP (Directory of Higher Education Environmental Programs) is a database of undergraduate and graduate interdisciplinary programs representing the full spectrum of environmental disciplines.

National Library for the Environment

<http://www.cnie.org/nle/>

Extensive information and resources: Congressional Research Service Reports and Briefing Books, 13 sources of daily environmental news, 300 online magazines-newspapers-radio-TV stations in 57 countries, 332 journals, directories, local information, population and environment linkages, careers and jobs, meetings and conferences, researcher's bookmarks, yellow pages, internet reference desk, state reports, and laws and treaties.

New Environmentalism—Reason Public Policy Institute

<http://www.newenvironmentalism.org>

A project of Reason Public Policy Institute and National Environmental Policy Institute.

North American Association for Environmental Education (NAAEE)

<http://www.naaee.org/index.htm>

A network of professionals and students working throughout North America and in over 55 countries around the world to promote environmental education and support the work of environmental educators in a cooperative, non-confrontational, scientifically-balanced approach that integrates this body of knowledge into all aspects of the curriculum. This site offers information on a variety of programs and activities, including NAAEE's Annual Conference, NAAEE publications and online services, and EE-Link.

Northwest Coalition for Alternatives to Pesticides (NCAP)

<http://www.pesticide.org/>

A nonprofit organization that provides information about environmental and health hazards of pesticides and offers alternatives to pesticide use. Recent campaigns include Clean Water for salmon, Inerts Disclosure, Pesticide Use Reporting, School Pesticide Use Reporting, and Sustainable Agriculture, as well as an on-going public education program that includes web access to over 150 detailed fact sheets, reports, and other educational materials free-of-charge.

Oregon Trout

<http://www.ortrout.org/for/forlinx.htm>

Oregon Trout is a nonprofit organization headquartered in Portland, Oregon. Their mission is to protect and restore native wild fish and the ecosystems that sustain them. This site will link you to their site of recommended links to other environmental related sites.

PEP National Directory of Computer Recycling

http://www.microweb.com/pepsite/Recycle/recycle_index.html

This is a state, national, and international directory of agencies that handle donations of used computer hardware for schools and community groups. Includes software reviews. A Northern-California-based group.

Pesticide Information Center

<http://picol.cahe.wsu.edu/>

Provides current information on all pesticides registered in Washington and Oregon. Can search by crop site, pest, or other choices. Includes label data, tolerance data, agrochemical and environmental news, and other information.

Plant Conservation Alliance

<http://www.nps.gov/plants/index.htm>

A consortium of ten federal government Member agencies and over 145 non-federal cooperators (biologists, botanists, habitat preservationists, horticulturists, resources management consultants, soil scientists, special interest clubs, nonprofit organizations, concerned citizens, nature lovers, and gardeners) working collectively to solve the problems of native plant extinction and native habitat restoration. Their Alien Plant link provides a national list of invasive plants infesting natural areas throughout the U.S., background information on the problems of invasive species, illustrated fact sheets that include plant descriptions, native range, distribution and habitat in the U.S., management options, and suggested alternative native plants, and selected links to relevant people and organizations.

Recycler's World

<http://www.recycle.net>

Here's a worldwide trading site for information relating to secondary or recyclable commodities, by-products, and used and surplus items.

Spatial and Environmental Information Clearinghouse WWW Server

<http://www.seic.okstate.edu>

An information link for locating and retrieving geospatial data.

St. Louis Science Center

<http://www.slsc.org/>

The St. Louis Science Center serves as a bridge between scientist and layperson, encouraging an understanding of ecology and the environment, humanity, technology and the space sciences and how each interrelates. By fostering an active interest in science and mathematics, the Science Center prepares people to make decisions that may shape the future and meet society's needs for scientific literacy. This site offers links to educational programs, teacher resources, online galleries, and a site for the kids.

Teacher Enhancement Electronic Communications Hall (TEECH)

<http://teech.terc.edu/index.htm>

TEECH is an electronic community hall set up to foster collaboration among leaders in teacher development. The project is funded by the National Science Foundation. It contains papers, lectures, discussions, projects, calendars, and links related to professional development, standards, frameworks, curriculum materials, and many other areas.

The Exploratorium

<http://www.exploratorium.edu/>

The Exploratorium's mission is to create a culture of learning through innovative environments, programs, and tools that help people to nurture their curiosity about the world around them.

The Weather Channel

<http://www.weather.com>

Includes forecasts, current weather, and other weather information.

Universities Water Information Network

<http://www.uwin.siu.edu>

UWIN disseminates information about water resources. Includes announcements, directories, research abstracts, employment listings, web links, and more. Links to American Water Resources Association, Inter-American Water Resources Network, and Universities Council on Water Resources.

U.S. Fish & Wildlife Service

<http://www.fws.gov/>

<http://www.r1.fws.gov/>

Include information on migratory birds, endangered species, freshwater and anadromous fish, national wildlife refuges, wetlands, habitat partners, coastal area conservation, and environmental contaminants. The second address is the Pacific Region (Region 1) home page.

Watch Over Washington Home Page

<http://www.wa.gov/ecology/wq/wow>

The Washington State Dept. of Ecology has launched a special website for volunteer monitors. This project is a joint venture with the Governor's Council on Environmental Education and its member agencies. Watch Over Washington is a statewide network of around 12,000 volunteer monitors who assess the condition of their local wildlife, soils, water, air, habitats, vegetation, land use, and other media. WOW supports stewardship by posting announcements of events, resources, training opportunities, success stories, tips, grants, tools, methods, reports, and frequently-asked technical questions and answers.

Washington State University Cooperative Extension Educational Materials

<http://www.caheinfo.wsu.edu>

You can search for bulletins, videos, reports, and other publications.

WaterWiser Home Page

<http://www.waterwiser.org>

Water efficiency clearinghouse with information and resources for water conservation.

Washington State Office of Environmental Education

<http://www.k12.wa.us/envedu/>

Provides information on Academic Standards and EALR's. Offers a catalog of information intended to provide the educator with access to materials that will assist him/her in the interdisciplinary instruction of environmental education arranged under the topics of Guidelines & Evaluation, Fresh & Marine Water Quality/Salmon, Pollution & Recycling, Agriculture & Energy, Ecology, Population & Ethics. Includes case studies of the Washington Model School Program and portfolios from the Model Links Environmental Education and School Improvement Program. Also, links to innovative environmental education programs worldwide.

OTHER USEFUL LINKS

Clark Public Utilities

http://www.oregonlive.com/news/third_party/energysavvy_2.ssf

<http://www.clarkpublicutilities.com/fastfact.htm>

<http://www.clarkpublicutilities.com/WhatsElec.html>

NW Natural Gas

www.nwnatural.com

Websites: www.epa.gov

Bonneville Power Administration

www.bpa.gov

Seattle Public Schools RESOURCE CONSERVATION

<http://www.seattleschools.org/area/logistics/energycon.xml>

Energy Audit Workbook (Advanced Work)

<http://www.energy.wsu.edu/ten/energyaudit.htm>

Energy Star For Schools Links Energy and Financial Performance

<http://yosemite1.epa.gov/estar/business.nsf/webmenus/Schools>

Green Schools, A Project of the Alliance to Save Energy

<http://www.ase.org/greenschools/teachers.htm>

Computers & Energy Use

<http://www.its.utas.edu.au/documentation/misc/green.text.html>

<http://www.camden.gov.uk/green/sections/urban/energy.html>

<http://www.swre.com/ee.htm#simple>

<http://greendesign.net/rmi/heb/comput.htm>

Destination Conservation Curriculum

<http://www.dcplanet.org>

Water Meter Reading

http://www.doh.wa.gov/ehp/dw/Word_Docs/5_Meter.pdf

Electric & Gas Meter Reading

<http://www.ase.org/educators/lessons/MeterReading.html>

Water Quality

<http://www.ci.vancouver.wa.us/cityflyer.pdf>

<http://www.ci.vancouver.wa.us/opcenter/waterquality/wq01/waterquality2001.pdf>

Environmental Services. Please call to request any additional information you'd like to have for your class.